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THE ALTERNATING-CURRENT ENCLOSED ARC.

The high efficiency of alternating-current enclosed arc lamps as compared with similar lamps operating on direct current makes the problem of their proper design one of great importance. As has been pointed out in these columns, the enclosed lamp is meeting with increasing favor for both street lighting and interior illumination, on account of its many points of superiority and excellence, but, so far at least, the direct-current types have been much more successful than those designed to operate on constant potential alternating circuits. The great desirability of good lamps for alternating current is not alone due to the existence of many alternating current installations in which they can be used, but as well to the higher efficiency which would result from the substitution of a reactive coil for the necessary resistance used in connection with the direct-current types.

The main difficulties which have beset designers of this class of arc lamps have been the humming noise emitted by the alternating arc, and the sensitiveness of the arc itself to small changes in the voltage across it. The paper in another page describing some experiments with a lamp of this type shows plainly how large a variation of light is caused by a small variation of voltage, and what close regulation of the supply current is required for good service.

Another difficulty with these lamps is their low power factor, causing a considerable flow of wattless current in transformers, lines and dynamos. This, however, is of minor importance when the high efficiency of the lamps and generators is considered. There is, perhaps, no greater desideratum in central station machinery than large arc generators for direct coupling to engines of reasonable size. The multicircuit constant-current machines have proven very successful, but their size is limited to two or three hundred light units, on account of the enormous potentials existing in their armatures. The direct current generator, feeding a three-wire system at 250 volts or thereabouts, requires a very costly line. The alternating-current generator, however, working at several thousand volts, and feeding districts of arc lamps though voltage transformers, presents a simple and efficient solution of the difficulty, if proper lamps for use with it can be had. To use the direct-current type of enclosed arc lamp on an extended distribution would involve the addition to such a system of rotary converters with the necessity of attendance and sub-station buildings. From all these considerations it is seen that tthe alternating-current enclosed arc lamp has a most excellent opportunity ready made and awaiting its perfection.

FASHIONS IN ENGINEERING.

As pointed out by Mr. George W. Dickie in a paper from which extracts may be found in another column, the electrical transmission of power has become fashionable, and for that reason is coming into much wider use and meeting with much greater success than would otherwise be the case. By this is meant that it has become a sort of fad with designers of engineering plants of all sorts to adopt, whenever it is possible, electrical apparatus in place of steam, hydraulic, pneumatic or other systems which might be or in the past were used. This is undoubtedly the case, and the interesting question arises, is this a temporary fad or a permanent change of sentiment? The

answer to this question depends on the success obtained with electrical apparatus, especially in those cases where it has been adopted more because it was fashionable than for more scientific reasons. Unlike most fads and fashions, there have not been recorded as yet any notable instances of the failure of electrical systems, and if the splendid record so far obtained can be maintained the fashion will undoubtedly become a fixed custom. Beside the well-known advantages that electrical methods have for many purposes, their popularity has undoubtedly been advanced by the neatness, cleanliness, the attractive appearance and the general "prettiness" of electrical machinery. The mysterious and still almost supernatural appearance to the lay mind of electrical phenomena has added to the popularity of electrical systems, owing to the interest and curiosity involved. The tremendous profits also obtained in some few branches of electrical engineering have greatly helped the fashion with the investors of capital.

ELECTRICAL AND MECHANICAL ENGINEERING.

The eighteenth annual meeting of the American Society of Mechanical Engineers was held in New York City from November 30 to December 3, inclusive. The most notable feature of this meeting to electrical men was the prominence given to electrical engineering questions. While this society gives its attention to the whole field of mechanical engineering, including railroad, hydraulic, pneumatic thermo-dynamic, and particularly constructional engineering, there were presented to this meeting two papers on strictly electrical subjects, and several others bearing on or referring to electrical engineering. The increasing use of electrical methods in all branches of engineering renders the subject of interest to engineers, no matter what their subject may be.

A MEASURE OF THE VALUE OF INCANDESCENT LAMPS.

The competition between different systems in lighting service is becoming so sharp that the managers of incandescent lighting systems are taking every care to economize in every step of the generation of their lighting currents. Boilers, engines, dynamos, lines and transformers of the highest efficiency are sought for, the saving of 1 or 2 per cent. being considered well worth while. Economies are also sought for by the use of conveyors, automatic stokers, etc. In this quest for the highest efficiency the transformation going on in the lamp itself is often forgotten. In the little filament, however, is the opportunity for the greatest loss and the most difficult place for the detection of loss. Incandescent lamps vary in efficiency between extremes which might be set perhaps at two watts per candle power and six watts per candle power. The importance of this variation may be more forcibly brought to mind by the consideration that the use of a six-watt lamp where a two-watt lamp might be used is the equivalent of the use of a dynamo of 30 per cent. efficiency in place of one of 90 per cent. efficiency. Probably the greatest cause of the neglect of the efficiency of the lamp is the fact that any saving in the lamp is a saving only to the consumer, when, as is usually the case, the lighting is paid for by meter registrations. The central station manager naturally does not care as much about his customers' losses as his own, especially when these losses increase his own business. This, however, is a short-sighted view of the case, particularly when in competition with other systems of lighting.

In an article in another column Mr. Francis W. Willcox discusses the quality of incandescent lamps, and attempts to define a standard of valuation based on the maintenance of candle power above an arbitrarily chosen limit. While undoubtedly the maintenance of candle power is a valuable factor in a lamp and should always be considered in the choice between lamps of different makes and different prices, it can hardly be considered the only factor in the value of the lamp. If, for example, a three-watt lamp could be obtained with the same life and the same maintenance of candle power as the four-watt lamp, its value would certainly be the greater of the two. The feature of long life with high efficiency is perhaps more important in the valuation of the lamp than the maintenance of candle power, although, in view of the conclusion of Mr. Wilcox, long life is rather to be deplored than desired, as short life will peremptorily force the substitution of new lamps about as soon as the candle power runs down to the minimum desirable limit.

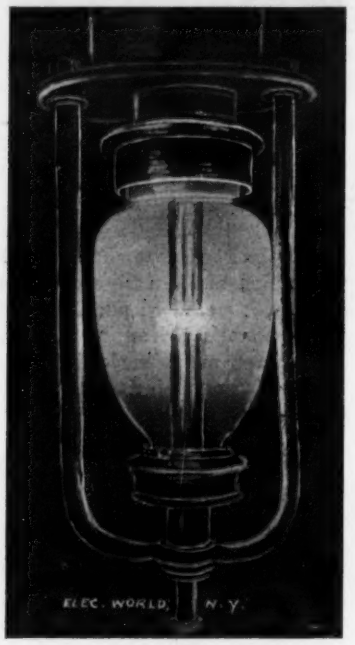
THE NEED OF PRECISE ELECTRICAL NOMENCLATURE.

The rapid extension of the use of certain alternating-current apparatus has shown a dearth of brief and accurate terms which would carry in themselves a definite idea. With apparatus only in laboratory or occasional use, methods and machines can be defined at some length without serious loss of time and space, but machines and methods in common use should be capable of precise definition in a few words. Details which develop slowly receive somewhere a happy characterization that becomes universal by merit of its fitness. More rapid developments do not allow time for this, and a certain looseness of expression ensues, which is a great hindrance to accurate statement. One of the most urgent cases of this kind is that of the various transforming devices for converting alternating currents to higher or lower pressures, continuous currents to higher or lower pressures, and alternating to direct currents, or vice versa. The term rotary transformer is coming to mean a machine in which alternating and continuous currents are mutually convertible in one winding. It is, however, understood by many to mean also a machine for converting continuous currents of one pressure to the same of another pressure. One prominent manufacturer of the latter type of machines has adopted the terms motor-dynamo and dynamotor to mean continuous current transformers with a variable and a fixed ratio of transformation respectively. These two terms are appropriate, self-explanatory and generally commendable, and it would be advisable if all manufacturers would put aside sentimental reasons and adopt them, leaving the term rotary transformer for the machine in which alternating and continuous currents are mutually convertible. To distinguish the alternating-current transformer, pure and simple, from the rotary, the term static transformer has come into some use. This, however, is objectionable, owing to the mental suggestion of electrostatic phenomena which it calls up. The term voltage transformer has been suggested in its place, but is not entirely commendable, owing to the fact that a motor-dynamo is as much a voltage transformer as is the humble alternating transformer with no moving parts. No altogether satisfactory term has as yet come to light for this distinction.

Another place where precise terminology is needed is in the distinction of the various types of alternating current generators. The term "inductor dynamo" is vaguely understood to mean a machine in which both the field and armature windings are stationary. A much more important consideration than the mechanical arrangement of the field coils is the magnetic condition of the armature cores. As generally understood, an inductor dynamo does not reverse the direction of the lines of force through the armature teeth, but dynamos might readily be made to do so with all windings fixed, or not to do so with field windings revolving. Still another variation is exemplified by a recent English design, in which the lines of force in any given lamina do not reverse their direction, but one-half the core tooth are magnetized in one direction, the other half in the reverse direction, the lines of force passing through the coil therefore varying between a positive and negative maximum. This machine may be made either with stationary or revolving field magnetizing coil. To just which of the various designs mentioned above the term inductor machine should apply, and what term should be used to specify the machine that is not an inductor type, is a problem.

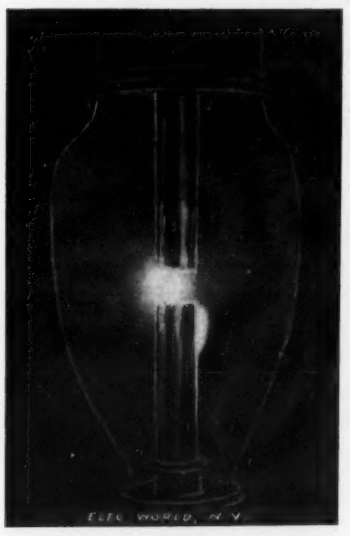
Tests of an Alternating Current Enclosed Arc Lamp.

Some interesting and instructive tests have recently been made on an alternating current enclosed arc lamp, and photographically recorded by the light of the arc itself, disclosing some peculiar features of this particular type of arc. The tests were conducted by Mr. M. H. Baker on the Puritan enclosed arc lamp, with the idea of showing to lamp users and central station men the appearance of the normal arc and the symptoms of the various troubles that may occur.

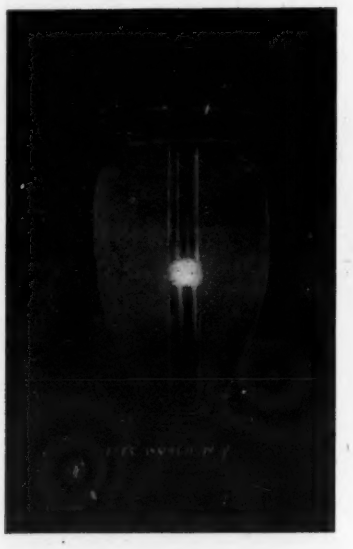


ARC SHOWING GLOBE, CLAMP AND BOTTLE CAP.

The Puritan arc lamp when working under normal conditions is supplied by alternating current at 100 volts pressure, the voltage being reduced to 65 volts across the arc by an inductive resistance, the pressure around which is also about 65 volts. When the normal current of 6 amperes is furnished, the apparent power consumption is obviously 600 watts. The real power consumption, however, owing to the lag due to the inductive resistance, is only about 400 watts. The actual loss of power in the inductive resistance, including both iron and copper losses, is from 25 to 35 watts, giving an

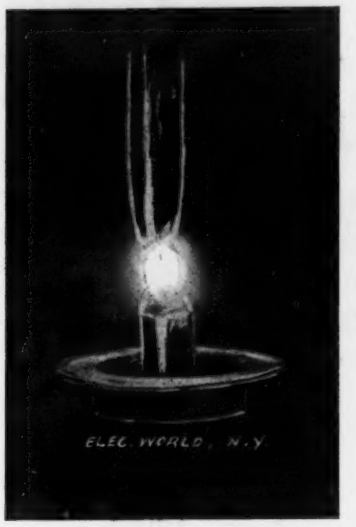


NORMAL ARC SHOWING ECCENTRICITY.



NORMAL ARC, 6 AMPERES AT 65 VOLTS.

efficiency, or ratio of watts consumed in arc to watts taken from the mains, of about 94 per cent. Careful experiments show that the resistance of the arc itself is non-inductive, the current through the arc being exactly—so far as can be determined—in phase with the E. M. F. applied to the carbons. The arc is enclosed in an inner globe, normally of opalescent glass, but for the purpose of these experiments of clear glass, clamped to the lower carbon with a packing of asbestos and covered with a heavy copper bottle cap, in which the upper carbon fits as closely as the requirements of free movement will allow. The length of the arc is controlled by a clockwork feeding mechanism and a series solenoid, the plunger of which is so arranged that as the current weakens the upper carbon is lowered until the minimum allowable length of arc is reached, when the clockwork detent is released, the upper carbon falls and the increased current causes the solenoid to again pick up the carbon. One-half inch "Electra" cored carbons are used, the cored carbons being found much better for alternating enclosed arcs than solid carbons, in that the arc does not with the cored carbons tend

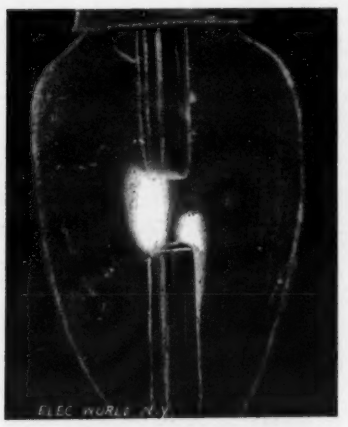


ARC WITH BROKEN GLOBE.

LAMP DESIGNED FOR 16,000 ALTERNATIONS ON 7,200 CIRCUIT.

to "climb" up the side of the carbon, as frequently occurs with solid carbons. The cored centres burn away, leaving central holes which seem to hold the arc in its travels close to the centre, preventing its running out to and around the edge of the carbons. The traveling and climbing tendency of the alternating arc appears to be greater than that of the direct current arc, owing probably to its frequent partial extinguishment. . The alternating enclosed arc is sometimes made with one solid and one cored carbon, by which the voltage may be raised somewhat, but the use of two solid carbons is practically impossible on account of the tendency to extinguishment.

The appearance of the arc when under normal conditions may be seen in one of the accompanying illustrations. The length can easily be determined by remembering that the carbons are one-half inch



VOLTAGE TOO HIGH.

VOLTAGE TOO LOW.

in diameter. The normal length is about 3/8 inch; the carbons' ends are flat, with fairly sharp edges, as may be seen. The effect of a broken enclosing globe or loose clamping about the lower carbons may be seen in the ragged or rounded appearance of the normally flat ends of the carbons. The greater the admission of air, and consequently the draught passing the carbons, the more will the ends be rounded until the conditions of the open arc are reached, when the end of the upper carbon is shaped practically like that of a sharpened pencil. This is obviously due to the draught of air

passing vertically by the arc and burning off the exposed surface of the carbons.

Another illustration shows the effect of abnormally high voltage on the arc. This was obtained by supplying a lamp built for 100 volts with current at 115 volts, the voltage across the arc rising to some 80 or 85 volts, owing to the increased length necessary to hold back the current. The flaming effect can be readily seen and its appearance should be noted, as it is invariably the sign of too great a current consumption for the size of the carbon. Such an abnormally large current consumption may be due to several causes, of which the following may be mentioned: Extra high voltage on the supply lines; poor adjustment of the regulating mechanism, or a lower frequency than that for which the lamp was designed, the last reducing the choking effect of the inductive resistance, thereby allowing more current to pass. An extreme case of the last cause is exhibited in the lamp built for 16,000 alternations and working on a circuit of 7200 alternations. In the reverse case of a lamp built for 7200 alternations and supplied with current at a frequency of 16,000 alternations the arc, as a rule, will not burn at all, owing to the extreme choking effect of the inductive resistance.

In the case of low voltage, shown in the illustration, a lamp built for 100 volts is supplied from a circuit at 90 volts pressure, the arc being shorter and weaker, owing to the reduced current. The minimum commercial current strength which can be depended upon for alternating enclosed arcs appears to be about 5½ amperes, smaller currents causing a rapid falling off of the illuminating effect and lighting efficiency.

The whole series of photographs exhibits, if the camera can be trusted, a highly interesting observation on the source of luminosity. In some of the photographs the centre of the arc appears to be a dark vertical stream from carbon to carbon, resembling the central dark stream of a Bunsen gas burner. This stream seems to be surrounded by an envelope of highly luminous vapor, which shares with the carbon tips the generation of the light. At either end of the dark central stream in some of the photographs appears a spot still darker by comparison, close to the carbon tips, and practically in a position where the appearance of a crater would be expected. The effect of the arc on the gases in the enclosing chamber is to form carbon monoxide, which is readily proven by the appearance of the blue flame at the top of the chamber when the bottle cap is removed.

Reduction in Cost of Steam Power.

In a paper presented by Mr. F. W. Dean at the New York meeting of the American Society of Mechanical Engineers, an analysis is made of the causes of the reduction in cost of steam power. Among other causes Mr. Dean mentions the use of reheating receivers between the cylinders of multiple expansion engines, the reduction of clearance, the increase in steam pressure and in number of expansions, and the maintenance of a good vacuum. The tendency of late to underrate the value of steam jackets is deplored in this paper, and their disfavor is laid to the hasty judgment of jackets which were either air-bound, water-logged, blowing through traps, or supplied through uncovered piping.

With regard to boilers, the statement is made that the horizontal return tubular boiler is still the standard of the country, and will probably so remain. It is cheap, and if properly built is safe. Its tube heating surface can be effectively blown with steam and its tubes can be effectively scraped at any time without taking the boiler out of service. The fire surfaces of water tube boilers can only be indifferently blown, and they cannot be scraped at all unless the boiler is cooled down, and in general it cannot then be done with anything approaching thoroughness. The internally fired boiler, either of the locomotive or vertical type, is highly commended on the score of economy of coal and the saving of brick work.

Economizers for heating water in smoke flues are credited with a saving of about 7 or 8 per cent. of the coal consumption. Vertical engines are recommended on account of the reduction of friction, reduction of repairs to cylinders and pistons and diminished cylinder oil consumption.

The attainment of further economy in the future is looked for mainly from the use of highly superheated steam. The use of very high steam pressures in quadruple expansion engines may be necessary, but highly superheated steam will so far avoid the cylinder condensation that it may be possible thereby to obtain extreme economy without resort to the multiple expansion engine.

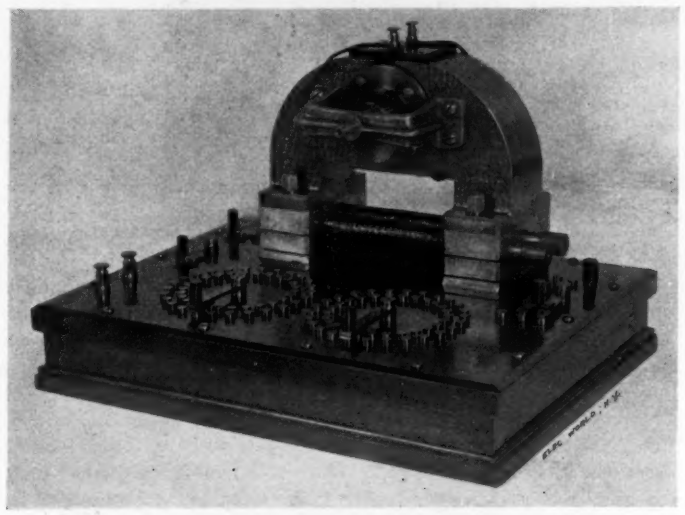
A New Magnetic Testing Apparatus.

BY ROBERT B. TREAT AND J. WALTER ESTERLINE.

Along with the gradual improvements in the methods of electrical design, there can be traced a simultaneous development in the different kinds of apparatus and accessories useful in determining data, or in testing machinery which has been built. The more recent methods of design and the high standard which has been attained in the manufacture of generators, motors and transformers, make it necessary for the engineer to have at his command an accurate, commercial means of testing the magnetic qualities of iron and steel.

With these facts in mind, the apparatus described in this article was designed and constructed by the authors at the laboratories of Purdue University, Lafayette, Ind. The work was begun in November, 1896, and two identical machines were completed in July, 1897.

In principle the apparatus embodies a combination of several well-known methods of testing, rather than the development of any new method, although it is believed that some new features have been brought out. The intention of the designers was to produce a form of apparatus with which it would be possible to determine both the permeability and the hysteresis of iron; an instrument adapted to the testing of solid and sheet metal made into a form of specimen easily shaped; and especially to give accurate results when used in an ordinary testing room, or when in the neighborhood of other



General View of Magnetic Testing Apparatus.

electrical machinery. It was also desirable that the results should be obtained from the tests without resorting to the long and tedious calculation which is necessary in some methods.

In the accompanying illustration there may be seen a view of one of the completed machines, which will give an idea of the size and general character of the apparatus.

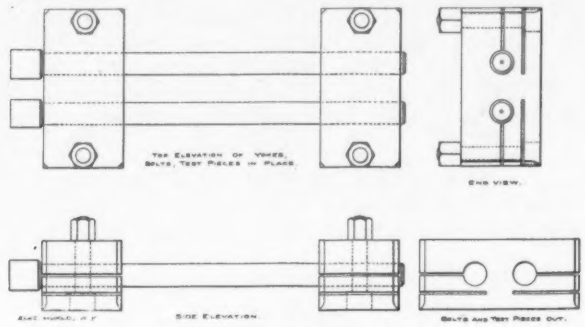
For solid iron the test piece used is a cylindrical rod, 10 inches long and .575 inches in diameter, as this form of specimen can be turned up accurately and finished without much labor. The side of the square inscribed in a circle of .575 inches diameter is approximately .41 inches, so the sheet metal samples are built up into square rods of this cross section. The strips are riveted together at the ends and milled smooth on the edges.

The ends of the test bars are clamped in two heavy wrought-iron yokes, shown in the working drawing; the holes in the yokes being cut a thousandth of an inch larger in diameter than the test bars, with two slots sawed in from the ends, as shown. The head of the clamping bolt rests on the middle portion, or that between the slots. In the tests made on the joints their reluctance was found to be very low, though not by any means negligible. The length of the portion of the test bar between the yokes is 12.566 cm. $= 4\ \pi$ cm. Holes are provided for two bars, and on each is a vulcanite spool, wound with 100 turns of silk-covered stranded conductor, capable of carrying 10 amperes.

A diagram of the wiring is shown, by reference to which the principle upon which the machine works will be readily understood. There are three distinct methods of operation, and each will be explained separately.

First—To test the permeability of a specimen by comparison with

a standard bar, whose *B-H* curve is known. The standard is clamped in the coil *A A'*, and the bar to be tested in *B B'*. The coils are wound so as to aid each other in driving the flux around the circuit made up of these two bars and the yokes, and when both bars are carrying the same number of lines of force, the difference of magnetic potential between the yokes is zero. The two coils are connected in series, and, having the same current, the relative magnetizing force of the two is equal to the relative number of turns. By means of the three-point switch, *M*, the number of active turns on the standard bar may be made either 50, 75 or 100, this arrangement making it possible to test bars of better and poorer grades than the standard. With any given density in the standard bar, the flux, through the test bar, is made equal to that in the standard by



DETAILS OF YOKES AND TEST BARS.

increasing the number of active turns on the test bar by means of the dial switches, which give a variation from 0 to 100 turns, in steps of one turn. An inner circle of contacts on the dials connects with idle coils of wire equal in size and length to those of the magnetizing coil; so that when a turn is "cut in" on the bar, one of equivalent resistance is "cut out" by the switch arm, thus keeping the current constant while a balance is being obtained.

O is a reversing switch for changing the direction of the current in the coils to eliminate hysteretic effects.

So long as the two bars are not at the same magnetic density, there exists between the yokes a difference of magnetic potential which sets up a flux through the magnetic circuit formed by the pole pieces and armature core, so that when the armature develops

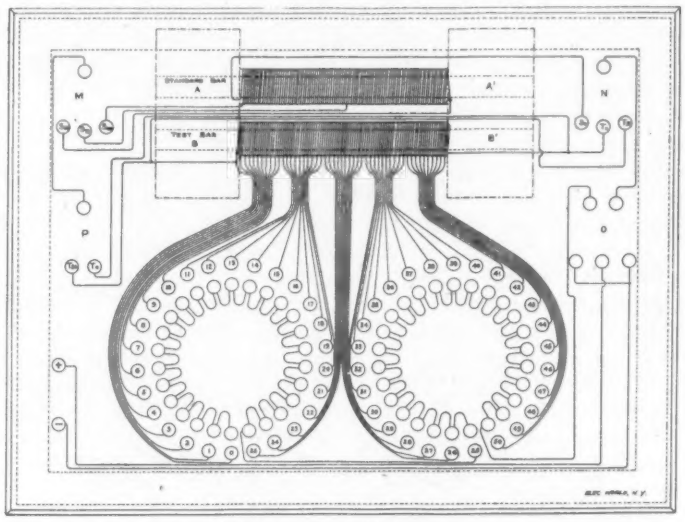


DIAGRAM OF CIRCUITS.

an E. M. F. we know that the bars are not balanced magnetically, a balance being obtained only when the armature develops no E. M. F.

The pole pieces are made of a fine grade of wrought iron, specially prepared and forged for the instruments. In order to reduce the reluctance of the circuit, the poles and armature are made rather large in proportion to the rest of the parts. The area of the air gap at the joint with the yokes is thirty-two times the area of the test piece. The polar air gap is one-hundredth of an inch across, with an area thirty-six times that of the specimen. The armature is driven at 4000 revolutions per minute and is of the ring type with toothed periphery. There are forty slots, and in each are wound 175 turns of No. 36, B. & S., double silk covered wire, making 7000 turns on the armature. The core is built up of fifteen mil stampings, and mounted on the brass end plates, which also serve to protect the wire on the ends of the armature. With a single line of force across the air gap the armature will develop an E. M. F. which is easily detected. Using a Weston milli-voltmeter, a balance accurate to one turn in 100 can easily be obtained, and may be more accurately determined by interpolating the throws of the needle of the voltmeter, which occur when a change of one turn is made in each direction.

To determine the hysteresis cycle of a specimen it is necessary to remove the standard bar and cut its coil out of the circuit by placing the arm of the switch, *N*, on the point, *T*. The total flux now passes through the armature circuit, and the density in the bar may be determined, as it is a function of the E. M. F. developed by the armature. The current is kept constant, and the magnetizing force increased by steps to a maximum by increasing the number of active turns. It is then decreased to zero, the current reversed and the operation repeated.

With the density in the bar at 17,000 gausses and the armature running at 4000 r. p. m., the E. M. F. developed is about 90 volts, which is within the range of an ordinary voltmeter, and insufficient to cause the burning out of the armature, even though it becomes accidentally short-circuited. The *B-H* curves may also be taken in the same manner as the hysteresis cycles, if care is taken to thoroughly demagnetize the bar before beginning the test.

The machine is mounted on a slate base, 12 × 16 inches, and beneath this is a hardwood sub-base, which contains the wiring and connections.

From the time of the first tests made, up to the present, both machines have been giving eminent satisfaction and good results in every way.

The Rating of the Economy of Electric Power Plants.

There are so many factors of an electric power plant that are measurable that there is a wide choice of ratios for the expression of the efficiency of electrical generation. Some engineers prefer the ratio of the kw-hours per pound of coal, and some the pounds of coal per kw-hour. Others, again, favor the use of the pounds of water in the expression of the output, and others still the amount of coal per kw-year, or its reciprocal.

In a paper presented at the New York meeting of the American Society of Mechanical Engineers, Mr. William S. Aldrich advocates the use of an expression involving the heat units supplied in the coal consumed, similar to the expression used in specifying the economy of pumping plants. It has become almost universal now to define the duty of pumping systems in terms of foot pounds per million British thermal units. The chief advantage of this rating would be that it would include the operation of the boiler, and that comparisons could readily be made between plants using different kinds of coal.

In the same paper the comparatively low economy of electric and other plants is commented upon. On a basis of 90 per cent. efficiency for the average dynamo of large size, the figures of 100 to 150 watt hours per pound of coal, given by tests on representative stations, appear surprisingly low when compared with recorded steam engine duties. For example, the report of the engine of the Chelsea Jute Mills, of Brooklyn, showed a coal consumption of less than 1½ pounds per indicated hp-hour, with a load varying from 495 to 765 horse-power. If a similar economy were effected in the electrical generating station, it should result in over 400 watt hours per pound of coal.

Mr. Aldrich states further that the economy of the modern high duty pumping engine is due to a refinement of design and economic arrangement of the installation, largely caused by the standard heat unit specifications, and the subsequent contract trials which have been customary. The introduction into contract specifications of rigid guarantees of efficiencies and economies in fixed standard ratios would probably go a long ways towards causing the economies of electrical generating stations to approach those of high duty pumping plants.

Consolidation of Iron Wire Interests.

The entire iron wire industry of the country is said to have been brought under the control of a single corporation, at the head of which is J. P. Morgan. The new corporation aims to control the manufacture of iron and steel wire and rod for all purposes, including telegraph and telephone line wire

The Importance of Quality in Incandescent Lamps.

BY FRANCIS W. WILLCOX.

We smile at the child's definition of an incandescent lamp—"A hairpin in a bottle," but there are numerous consumers and purchasers of incandescent lamps to whom it is nothing more, who never have understood or appreciated the difference between good and poor lamps, or esteemed the great importance of quality.

One of the greatest drawbacks to successful electric lighting today is inattention to lamp quality, disregard of the proper value of a lamp, its quality, and consideration only of the apparent value —first cost. Poor quality lamps are like barnacles on a ship—they retard the free progress of successful illumination and convert what might be an active and successful business into a slow and uncertain one, unable to do much more than drift at the mercy of the waves of gas and oil competition, and fortunate if indeed it escape utter shipwreck.

The importance of quality in incandescent lamps can hardly be exaggerated. The lamp is the end and aim of the whole lighting system. It is the final translating device which transforms the current into light. Its quality becomes, therefore, like an object at the focus of a microscope, magnified into the greatest importance.

There is little dispute but that it is the best to use good and efficient machinery in electric lighting stations, that it is wise to have a well proportioned and constructed distributing system. How then can there be any question of what should be an electric lighting axiom? viz., That only incandescent lamps of the highest quality should be used. What folly for a station to install good machinery and well proportioned lines to supply current to poor lamps. It would as wise for a steamship to have quadruple expansion engines to drive an inefficient propeller.

A good incandescent lamp often overcomes the result of bad machinery or bad management, but poor incandescent lamps will destroy the results and efforts of the best equipped and most capably managed electric lighting installation in the world.

There can be honest differences as to whether it is wisest or best to buy the best wire, or this or that cut-out, or a cheap type of socket in preference to a more expensive one, but as regards the lamp there can be but one decision—the best lamp is none too good. This is because the lamp is the chief and final device that produces the light and establishes the quality of the commodity for sale.

There are many who will probably concur in all that has been said to the extent of avoiding the poorest grades of lamps, but who do not consider that minor differences of quality are of any importance, and who actually believe that it is economy to purchase lamps, even if they are inferior to the best, provided they can be bought cheaper.

It is the purpose of this article to point out the error of this, in demonstrating the great importance of quality and how many times more important it is than any saving in first cost.

The quality of a lamp is determined by the average light it furnishes during any given period. As is well known, all lamps decline in candle power as they are used. It is the relative amount of the decline, other things being equal, which determines the value of a lamp.

Fig. 1, for example, gives the curves of candle power of two lamps, and the quality of lamp No. 2 is at once seen to be superior to that of lamp No. 1 in the better holding up of the curve of candle power. Both lamps are of similar voltage and candle power, and were tested at the same exact initial efficiency under the same exact conditions. It is the practice of the best modern stations to take the period in which a lamp loses 20 per cent. of its initial candle power, and from this determine the candle hours of light given, taking these as the measure of the lamp value. The area included between the candle power curve above the 80 per cent. value and the zero line of candle power gives the candle hours. All the lamps tested were between 16 and 20 cp, and burned on voltages of 115 to 120. They were tested at an initial efficiency of 3.1 watts per candle.

For example, in Fig. 1 the area enclosed beneath curve No. 2 is indicated by the letters *a b c d;* that beneath curve No. 1 by *a e f d.* By means of a planimeter these areas are measured, and with proper scale of candle power and hours, the areas represent the exact number of candle hours given by the lamps under consideration. The areas of the lamps Nos. 1 and 2, in Fig. 1, have been integrated by a planimeter, and are as follows:

Area of lamp No. 1—*a e f d* equals 1500 candle hours.
" " " 2—*a b c d* " 6000 " "

Comparison of the two curves, Nos. 1 and 2, shows that lamp No. 1 reaches the 80 per cent. lne in about one-fourth of the time that lamp No. 2 does. To obtain the same amount of light, it would be necessary therefore to renew lamp No. 1 about four times as often as lamp No. 2, which on the basis of first cost of the lamps would make lamp No. 2 four times the value of lamp No. 1, and this we see is the ratio of the respective candle hour areas.

This method of comparison correctly and fairly determines the value of any make of lamp, but it is quite difficult, if not impossible,

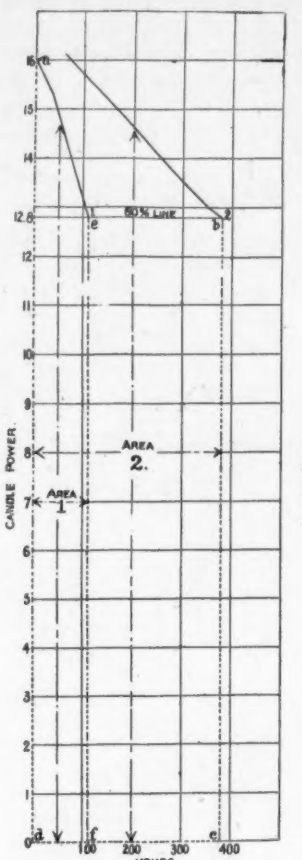


FIG. 1.—AREAS SHOWING CANDLE HOURS WITH 80% MINIMUM.

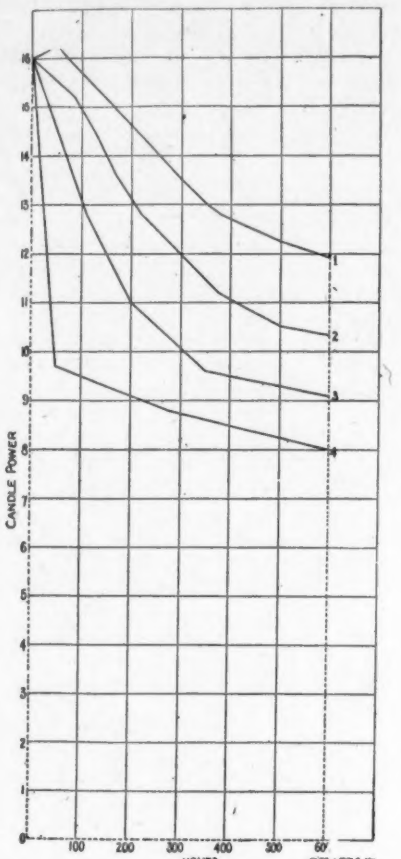


FIG. 2.—AREAS SHOWING CANDLE HOURS ON 600 HOURS LIFE.

for the average station to determine when a lamp has lost a given percentage of its candle power, and, therefore, difficult to renew lamps on this basis, that is, replace lamps whenever they have lost 20 per cent. of their initial candle power.

If there was a practical plan for the average station to renew all lamps on its circuits at the period when the candle power had diminished to a certain degree, it would be far preferable to the present generally accepted methods of letting lamps burn until they burn out or get so dim as to be practically useless, or of allowing them to burn a fixed average life of 600 to 1000 hours; but as the most prevalent practice is to let lamps burn for a given number of hours we will adopt a modification of the foregoing method of determination of quality.

We will extend the curves of candle power to 600 hours and take the area beneath each of these curves in candle hours as the measure of value. The various makes of American lamps have been purchased and tested and classified into four grades. The accompanying diagram (No. 2) gives the curves corresponding to each grade.

Taking the areas included between each curve up to the 600 hour line and the zero line of candle power, we have:

Area of lamp No. 1 to be 8200 candle hours.
" " " 2 " 7500 " "
" " " 3 " 6500 " "
" " " 4 " 5450 " "

Assuming area of lamp No. 1 as the standard, representing it by 100 per cent., the difference in candle hours given and the percentage value of the other lamps, is as follows:

Relative Value of Lamps.	Difference in candle hours of light as compared to best lamp.
No. 1.....100 per cent.	No. 1
No. 2..... 91 "	No. 2— 700 candle hours or 9 per cent.
No. 3..... 80 "	No. 3—1700 " " 20 "
No. 4..... 66 "	No. 4—2750 " " 34 "

From these comparative values one might conclude that if lamp No. 1 cost 20 cents, then lamp No. 2 would be worth 91 per cent. of

20 cents, or 18.2 cents; lamp No. 3, 80 per cent. of 20 cents, or 16 cents, and lamp No. 4, 66 per cent. of 20 cents, or 13.2 cents. This result, however, only considers the first cost or selling price of the lamp. A proper measure of the differences in quality as compared to the best lamp should consider the cost of the difference in candle hours, *i. e.*, the value of the light lost. What is the value of this difference in candle hours or lost light, ranging from 9 per cent., or 700 candle hours in lamp No. 2, to 34 per cent., or 2750 candle hours in lamp No. 4 ?

Assuming the station cost of a lamp hour at the low value of ¼ of a cent, the value of 600 hours of the best lamp would be $1.50. On this basis of the value of the light given by the best lamp, the value of the candle hours difference, or the light lost by using lamps Nos. 2, 3 and 4 is as follows: .

Lamp No. 2. Difference or light lost, 700 candle hours, 9 per cent.; value 13.5 cents.

Lamp No. 3. Difference or light lost, 1700 candle hours, 20 per cent.; value 30 cents.

Lamp No. 4. Difference or light lost, 2750 candle hours, 34 per cent.; value 50 cents.

If now we assume that the lowest grade lamp, lamp No. 4, could be purchased for 1 cent, the values of lamps Nos. 3, 2 and 1, when the cost of the difference in candle hours of light is considered, would be as follows:

Lamp No.	4	assumed as worth....	1	cts.*
"	"	3	becomes worth.....	21	"
"	"	2	"	"	27½	"
"	"	1	"	"	51	"

This table strikingly shows the value of the difference in quality of incandescent lamps. It is to be noted that this value is estimated upon a very low basis of cost—¼c. per lamp hour.

From the standpoint of the customer, who pays at least three times the cost assumed above, that is, ¾c. a lamp hour, lamp No. 1 becomes worth $1.50 as compared to 1c. for lamp No. 4. It is from this, the customer's standpoint, that the matter should be regarded.

Whether it be as a result of supplying poor lamps, or allowing supply houses to sell customers poor lamps, the loss to the consumer is direct and paid for in dollars and cents. The fact that the customer purchases the inferior lamp does not relieve the station from blame or the responsibility of the loss in value of light. The customer can hardly be expected to know or appreciate the value of lamps—it is the station's business to protect him by furnishing or allowing to be sold to him only lamps of the best quality. Otherwise there is dissatisfaction and loss of business, as the customer always blames the station for poor service.

The answer to those who consider minor differences in quality unimportant is found in comparison of lamps Nos. 1 and 2. Here there is only a difference of 9 per cent. in candle hours of light given, and yet the value of lamp No. 1 (51c.) is 13½c. greater than that of lamp No. 2 (37½c.) estimating light at cost value. Estimating light at what it costs the consumer, the difference in value between the best and the next best lamp is more than 40c.

We have assumed a very low figure for lamp No. 4 in taking its value at one cent, in order purposely to emphasize the difference between the best and the poorest lamp. As a fact, the selling price of the poorest lamp made is only a few cents below that of the best.

Where can be the gain to a central station in saving two or three cents on a lamp and losing 50 cents' worth of light, or, from the customer's standpoint, where is the wisdom in supplying customers with a lamp two or three cents cheaper than the best on the market, and causing him to lose an amount of light which represents $1.50 in value to him?

Were central stations to ask themselves such questions and give more consideration to this subject of quality, there would be fewer stations suffering from Welsbach competition and unprofitable lighting business.

An Investigation of the Economic Basis of Quasi-Public Institutions.

The Department of Labor of the United States Government is about to undertake an investigation into the financial status of the gas works, water works, electric light and power plants throughout this country.

*Lamp No. 1 is worth 1 cent, plus the value of lost light—50 cents—or 51 cents.
Lamp No. 2 is worth 1 cent, plus the difference in value of lost light between lamp No. 4 and lamp No. 2; that is, 50 cents—13½ cents, or 36½ cents, plus 1 cent, giving 37½ cents.
In same the value of amp No. 3 is estimated.

Auxiliary Engines and Transmission of Power on Naval Vessels.*

BY GEORGE W. DICKIE.

The advocates of electrical systems have an argument for their method of power transmission which those who favor any of the other methods do not possess, in the fact that all modern warships have a certain amount of power converted into electric energy and distributed throughout the ship for lighting purposes.

Another advantage which electricity possesses, here as everywhere else in the field of applied mechanics, is that young engineers are educated into the knowledge of how best to generate and apply this agent in a manner which has never been thought necessary in regard to other forms of stored-up energy, and, it being the fashionable agent for power distribution throughout the engineering world, its development is one of the modern wonders of engineering.

An electric installation for all power purposes on board warships will, on account of the education of the engineers or other officers in charge, receive more intelligent care and more skillful application than any of the other methods which we have considered.

While this advantage is not inherent in the system itself, it is of the utmost practical importance in its successful application.

The transmitting wires of the electric system possess a flexibility which cannot be claimed for the pipes of the other systems. This is an important advantage in the crowded compartments of a warship.

As to safety, economy and comfort, we may now consider these in comparison with other systems.

In regard to safety: We might safely take it for granted that whatever disturbance would fracture the pipes of an air or water system would part the wires of an electric system. In that case the danger to life, and also to the ship, would be far greater with the electric system than with the others. Automatic safeties could be applied to almost any conceivable extent against such accidents, yet, where safety devices are needed the system cannot be so safe as where no safety devices are needed.

There is also a growing fear among marine engineers that certain materials are rapidly destroyed by electric action, caused by the hull of the vessel becoming magnetized in some way the nature of which is not yet fully understood. It is claimed that vessels fitted with electric generators develop rapid deterioration in all sea-water pipe connections. Whether sufficient reliable data have been collected either to establish or refute this claim is, we think, doubtful. It is a question which we think ought to be most fully investigated. At present it is simply a matter of conjecture, and to marine engineers a matter of considerable uneasiness.

As to economy: The electric generating plant has been developed, both electrically and commercially, to a high degree of efficiency. Direct-operated generators are now driven by engines of the very highest developed type. These engines are so perfectly controlled by automatic valve governors that full load or no load may be the condition without apparent change in the working of the steam motor.

The generators may be so divided into units as to meet the conditions of work at any time without much of the steam engine power running without load. Lighting and power can be taken from the same installation, thus effecting a saving in the labor of attendance. There is no doubt that the economy of generating the power electrically will be better than with either water or air, owing to the high speed of the engines and the small amount of loss in the generating mechanism.

In regard to the distribution, the losses, by careful installation, can be reduced until they shall at least not exceed the losses of friction in either air or water pipes of the other methods. Careful designing may also reduce the losses in converting the electric energy into mechanical movements, so that the economy of this part of the system may be better than in either air or water motors.

All this class of work has been so perfected that every function requiring power on a warship can be performed by electric motors, without involving the use of anything except well known and tried mechanism.

It is not our purpose in this paper to give the details of operating motors for windlass, winches, capstan, boat cranes, steering gears,

* Extracts from a paper presented at the New York meeting (December, 1897) of the American Society of Mechanical Engineers

ventilating fans, ammunition hoists, gun-mount manipulating gears, etc., as none of these operations involve the use of any electric device which is not now well known.

In operating large turrets, where the mass to be removed and controlled is very great, and on a continually shifting plane, we believe that some controlling mechanism of a special character will be required to insure successful and accurate movements of such masses on a moving platform.

For this purpose we have introduced a hydraulic control device, consisting of two hydraulic cylinders, double-acting, their pistons operated by a double-throw crank shaft, which forms one of the transmitting shafts between the electric motor and the fixed rack under the turret. These cylinders are charged with water or oil. Motion of the turret revolves the crank shaft and moves the pistons in the cylinders. The fluid must pass from one side to the other to permit of such motion. This it does through passages connecting the ends of the cylinders. There are two such passages, one being controlled by a valve operated from the sighting station, and opened as the current is turned on to the motor. The other is controlled by a spring-loaded valve and gives a fixed maximum retarding force. This is necessary, as, if the hand control were closed too quickly, the momentum of the moving mass would break the mechanism.

We also propose to avoid great waste of current in starting this heavy mass, by using a small high-speed motor to effect the first movement, or for small movements of the turret. If it is necessary to throw the current into the main motor, a certain speed is reached before that is done; consequently the shock and waste of current is avoided, as the main motor would only be used when a high speed of train is required, and then only after the inertia of the mass has been overcome. In making these movements the small motor is allowed to reach its load, when the current is switched into the main motor. The current in the small motor also excites a solenoid which, by proper mechanism, couples the shaft of the small motor with the pinion that, through a gear of, say 10 to 1, works the shaft of the main motor; but when the current is turned into the main motor the solenoid is cut out and the clutch withdrawn, thus leaving the small motor at rest.

The actual economy which would result from such a method of operation could only be determined by actual experience. But we feel confident that it would prove to be in advance of the economy possible with either air or water.

One other reason for expecting a good economical result from a complete electrical power transmission lies in the fact, already mentioned, that this system would receive more skillful attention on the part of the officers in charge than any of the other methods mentioned. The whole installation would be more attractive to the educated engineer. It is the fashionable power of the day, and young men are more eager to give their attention to this than to any other form of generated energy; and if any system is the thing desired by those who are to have the operating of it that system will give better results, will be more carefully nursed, and will be studied in all its details, with the object of improving every result obtained. This is natural, and must be considered in connection with any proposed advance in engineering methods.

Some time ago we were fitting the Howden system of forced combustion to a vessel, the engineer of which did not believe in its merits; but he was honest, and assured us that he would do nothing to prevent it being a success. It was necessary to find another engineer who would do everything he could to help make it a success before success came. So the fact of electric transmission being desired by so many engineers is one point in its favor which will secure the care that means economy, apart altogether from the inherent qualities of the system itself as compared with others.

In regard to comfort, it cannot be claimed that an electric system of power transmission on a warship, like a compressed-air system, can be made the means of increasing the comfort of living on board. On this point it should rank with a hydraulic system. The facility with which electric energy can be converted into rapid rotary motion makes ventilation wherever that power is distributed a very simple matter, and electric fans, both fixed and portable, especially where little or no heat is generated, can be made to supply pure air to all parts needing artificial ventilation.

This paper does not aim to show the superiority of any one system over another, the comparisons made being simply to show that there is no mechanical difficulty in operating all auxiliaries by any one of the systems herein mentioned, and to express a hope that our Government will either adopt some one system and carry it out complete, developing that system to its utmost efficiency, or or else take one or two similar ships and fit them with power transmission systems completely representing the different agents.

While we have hitherto advocated with all the ability we possess a complete hydraulic system, our experience in the practical working of hydraulics on shipboard has not been of the most pleasant character. Officers are required to care for and get the best out of a hydraulic system, while personally they would rather sit up all night with an electric plant than spend a moment more than the law requires with a water motor.

The future hopes of the young officer are centred in electricity, and he devotes himself to it with a will; and so long as that condition prevails the electric method of transmission will have the best chance to succeed, because with that it has a flexibility and a general adaptability which the other systems do not themselves possess.

The Starting of Alternating Current Single-Phase Induction Motors.

As is well known, the single-phase induction motor is a highly effective piece of apparatus when running at its best speed, which is just below synchronism. When at this speed it acts very similar to the better known multiphase induction motor; but at lower speeds, and especially at zero speed, its behavior is entirely different. For a starting device it has been customary to build such motors with an adjustable resistance in the secondary element similar to the starting device of polyphase motors, and also with an auxiliary winding in the primary element through which a derived current, displaced in phase from the main current, could be passed, thus giving a sort of combination pulsatory and rotating field, with sufficient torque to start the motor without load.

Various methods of obtaining a phase difference between the current in the auxiliary winding and the current in the main winding have been devised. One of these is the use of an electrolyte. Others depend upon the use of condensers and inductive resistances. They are all, however, only makeshifts, and only give a sufficient torque for starting under no load, and with the disadvantage of wattless currents in the main line.

In a paper read before the Italian Electro-Technical Association, Prof. R. Arnò, of Turin, discusses the problem and shows that, with a proper design of the various parts, the single-phase induction motor can be readily made self-starting in a much more simple way. His method does away with the use of an auxiliary winding, the motor requiring only for starting an adjustable resistance in the secondary element. If this resistance is made of the proper value, which he deduces mathematically, and which he shows to be slightly less than the critical value at which the motor will not run at all, a slight turn of the armature will generate a considerable torque, which will rapidly accererate the machine on light loads. As the single-phase machine with a single winding will run equally well in either direction, the turn in either direction will generate a torque acting in that same direction up to full synchronous speed. The curves of torque and speed, worked out by Prof. Arnò for various conditions, show that with this critical value of the secondary resistance the torque rises with the speed abruptly from the zero point of the speed and torque co-ordinates. So steep can this line be made that a slight pull on tthe belt or a twist of the rotor through a quarter turn will cause a torque that will accelerate the machine promptly, the torque raising to a maximum at about one-half synchronous speed, when, by reducing the resistance of the secondary to a short circuit, the torque can be increased to a maximum slightly below synchronism, the motor acting exactly similar to a polyphase induction machine.

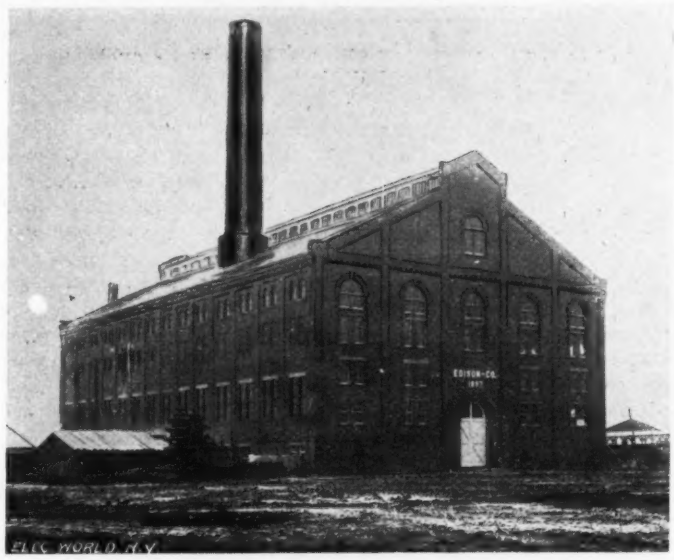
In a later paper by the same author, read before the same association on October 24, the tests of this method on some Brown motors in the electrical works at Intra were described. Three motors designed for 12, 25 and 110 horse-power respectively were fed from the single-phase alternating circuits with a frequency of 42 cycles per second. The large motor worked directly on the high tension circuit at 3000 volts; the small ones on the 110-volt secondary circuit. Previous to the tests described, they were started up by a method of C. E. L. Brown, requiring an auxiliary current thrown out of phase by an electrolyte. The motors, when the new method was applied, started with a very slight directive turn, and with a starting current hardly any larger than the normal running current under the same load.

Progress of Work on the Generating Station of the Brooklyn Edison Company.

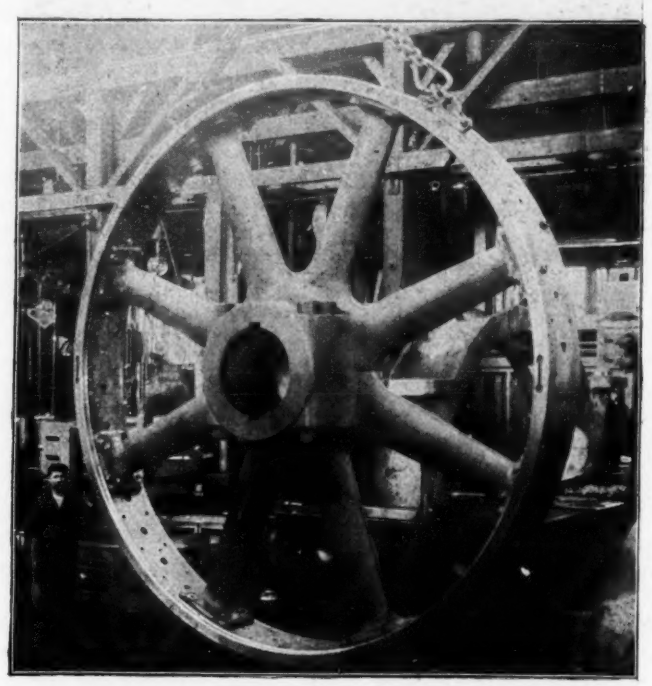
As has been noted frequently in the columns of the technical press, the Edison Illuminating Company of Brooklyn is building a new generating station on the water front, for the production of multiphase high pressure alternating currents. The new station is to be of sufficient size to generate the power for the whole system, the current to be transformed in sub-stations fitted with rotaries, and possibly storage batteries, and distributed over the existing low pressure network. The new station, which involves several novel and interesting features, is located at the foot of Sixty-fifth Street, Brooklyn, in the neighborhood known as Bay Ridge, on the water front of the upper bay of New York Harbor.

The building, which is shown in the accompanying illustration, is a plain rectangular structure of red brick, with a simple truss roof of considerable pitch, surmounted by a monitor at the peak of the truss. The dimensions are about 100 by 180 feet in plan, the height from the ground to the eaves being about 50 feet. The structure stands by itself, no other building of any magnitude being near it, and it is therefore easily lighted from all sides. The monotony of the plain walls is relieved by pilasters, which divide the walls into panels and greatly stiffen the construction.

From almost the central point in the roof of the building there emerges a great steel stack of circular cross section, 12 feet in



EXTERIOR OF THE NEW BROOKLYN EDISON STATION.



SPIDER AND RIM OF FIELD RING.

diameter and 235 feet in height from the capstones of the foundation to the top of the stack, the foundation being 15 feet nigh above the ground level, giving an aggregate height of 250 feet. The stack is supported without guy lines, its lower end being coned out to a diameter at its base of 24 feet, giving a solid footing. The height available for draught is 230 feet, as the boilers are placed on an elevated platform about 20 feet above the ground level.

The boiler room is planned for two batteries of Aultman & Taylor B. & W. type boilers, one battery of six being already in place and ready for use. Two of these boilers are already under steam. Each boiler is fitted with mechanical stokers, engine-driven, and automatic coal-feeding apparatus and ash dumps, by which the ashes can be lowered at will into a car which runs on a narrow-gauge track in the chambers beneath the boilers. This space beneath the boilers is much larger than that customarily left there, and provides a suitable place for the feed pumps and forced-draught blowers. The feed pumps for regular use are motor driven. Two of these motors are already installed, of 20 horse-power each, General Electric four-pole type, taking current at 230 volts. The motors drive the pumps by single reduction gears. For service in case the electrical system should happen to be shut down, auxiliary duplex steam pumps are also provided. The pumps discharge into a water-pressure main, by means of which any or all the boilers can be fed from any or all the pumps. Running the whole length of the chamber there is also a large galvanized iron air supply pipe, properly connected, to give forced draught to any or all of the boilers. This pipe is supplied with air by three No. 10 Sturtevant blowers, arranged overhead, and bolted to the under side of the floor beams of the boiler room. Each blower is belted to a General Electric four-pole 25-hp direct-current motor.

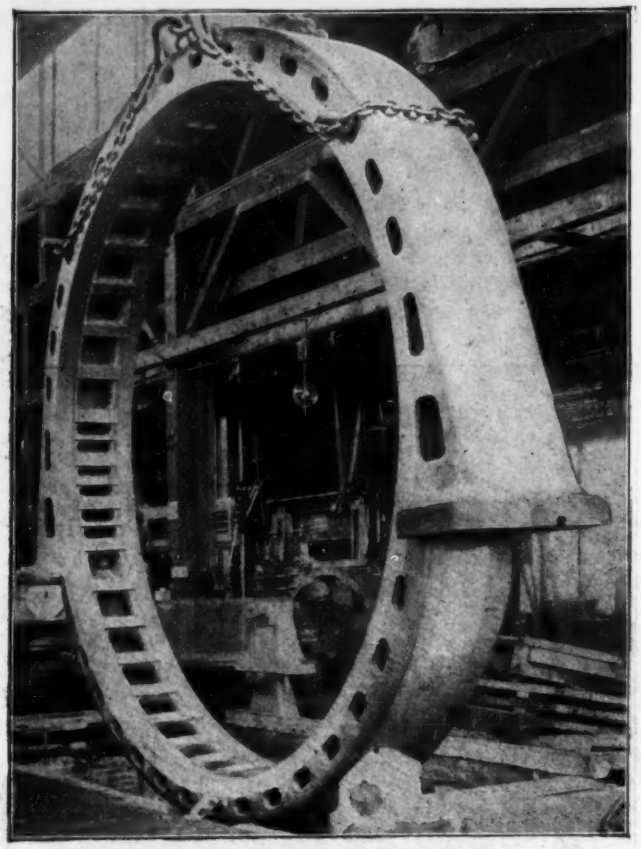
The coal supply for the station will be taken from canal boats at the dock, a short distance from the station, and carried by coal conveyors, either to the boiler room direct, or to the coal storage bins, which will be built immediately south of the station, with a capacity of 2000 tons. Coal bunkers are also to be built above the fronts of the boilers, from which the automatic stokers will derive their supply, the feed of the stokers being effected by a coal driving screw, driven through a worm wheel and worm by a small steam engine, the rate of coal supply being varied by changing the speed of the engine. The ash railway will be continued out to the wharf, the dumping cars being arranged to empty either into wagons or boats.

The north side of the station, which is separated longitudinally by a fire wall from the south side, contains the engines and generating machinery. The engine room floor is, like the boiler room floor, elevated some twenty feet above the ground level, the machinery being all supported on wrought steel columns. This allows the placing of all piping, condensers, wiring and auxiliary machinery below the engine room floor, giving the room a very pleasing appearance, and allowing the greatest of freedom for the working of the overhead crane.

The engines, one of which is already installed and working under steam, are McIntosh & Seymour horizontal twin tandem compounds. The cylinder dimensions are 24 and 48 inches diameter, the stroke being 66 inches. With 165 pounds steam pressure at 75 revolutions per minute they are capable of working up to 3000 horse-power. Their greatest economy is affected at about 2000 horse-power. The two cranks are set 180 degrees apart, for purposes of balancing and the simplification of the valve gear. The valves are the latest type of the McIntosh & Seymour make, consisting of long, narrow gridiron plate valves with eleven passages, working in valve chests across the upper and lower sides of the cylinders, there being four valves to each cylinder. The two upper valves, one at each end of the cylinder are the steam valves; and are fitted with auxiliary cut off gridirons on the back of the main valve. The valves are all driven by positive motion, one eccentric and rock shaft driving all the main valves of all four cylinders. The cut-off valves are driven from another eccentric, the angular advance of which is governed by a shaft governor. These valves give a very small clearance and very rapid valve opening, owing to the multiplicity of their passages.

The engine is fitted with an exceptionally heavy fly wheel, which is sufficient to carry the engine over the dead centres with full load with a velocity variation less than one-quarter of 1 per cent. The engines exhaust into a common exhaust header, from which

the condensers situated in the spaces below the engine room floors take their supply of steam. The latter are Worthington surface condensers, their auxiliary power apparatus being entirely motor driven, by which a far greater economy of steam is effected than in the customary small steam-driven apparatus. The circulating pumps are of the ordinary centrifugal variety, direct-coupled to 20-hp General Electric four-pole motors. The air pumps are of the



Frame of a Stationary Armature.

customary reciprocal type, and are also connected to similar motors.

Running the entire length of the station, and from there out to the ocean, there are two large bricked-in tunnels about 8 feet in width and 12 feet in height from the floor to the spring of the arch. Through one of these the cold water enters and is drawn to the circulating pumps, the warm water from the condensers being discharged into the other and carried back to the ocean. The intake is carried out beyond the outflowing tunnel to prevent any return of the warm water discharged.

Only one of the engines and generators has so far been erected, there being space for twelve of these generating units side by side. The first one, as soon as it is ready for use, will carry the load at present generated at the DeKalb Avenue station, the current being there transformed by rotaries.

The engine room is spanned by a traveling crane fitted with electric motors and running the whole length of the building, with the exception of a short section at the front, which is occupied by the offices. A railroad track was carried into the station, on which the cars of machinery could be run to such a point that the crane could readily swing them directly from the cars to their final positions. The motors of this crane and also those of several pumps have been operated during the whole time of construction of the station by alternating current transmitted at high pressure from the older stations of the company, and transformed by a temporary equipment of voltage and rotary transformers in a shed at the rear of the station. This plant was placed without any special foundation, and was attended to by one man, the expense being much less than that of the steam boilers, hoisting engines and pumps, the work of which it accomplished.

Between the two overhung cranks of the main-generating units will be the the 1500-kw three-phase alternating-current generators. These are being built by the General Electric Company, one machine having been already delivered. They are of the revolving field ring type, with stationary armature winding. The stationary armature ring is 31 feet 2 inches high from top to bottom, its length in the direction of the shaft being 51 inches. The total weight of the whole machine is 163,000 pounds. The revolving field frame is built on a massive steel ring riven by eight heavy cast iron spokes, the hub being keyed to a 27-inch shaft. There are forty field coils, built up of annealed laminated iron and wound with heavy copper strips laid up edgewise. The weight of the revolving field is approximately 60,000 pounds.

This machine will generate three-phase current at 6600 volts, the insulation being built with special care to stand this high pressure. The dynamos will be run in multiple when more than one is in use, their current being distributed over the high pressure network and transformed in the various sub-stations for the different services supplied by the Edison Company over the whole of the borough of Brooklyn, a district covering some 75 square miles. The greater part of the current will be transformed down in sub-stations by voltage transformers and by rotaries to direct current at 230 volts, which will be fed into the existing underground lines of the company. Some series arc-light circuits will, however, be supplied by dynamos driven by synchronous motors taking current at full line pressure. A large number of rotaries of various sizes are being built for this service by the General Electric Company and the Excelsior Electric Company. The low frequency of 25 cycles per second has been adopted, owing to the comparative ease of building rotaries for this low frequency, and the fact that most of the current will be transformed in rotaries before its final distribution.

The Relative Size of Compound Engine Cylinders.

In a paper presented by Prof. Robert H. Thurston and Mr. Louis L. Brinsmade at the recent meeting of the American Society of Mechanical Engineers, the proper proportioning of the cylinder volumes of multiple expansion engines for greatest economy was thoroughly discussed. The paper described the results previously found by Mr. Rockwood, tending to show that a compound engine with a much smaller high-pressure cylinder than that customarily used gave surprisingly high economy. This result was found by the test of a triple expansion mill engine, which gave a steam consumption of 12.67 pounds per indicated horse-power when developing 199 horse-power, using all three cylinders with a boiler gauge pressure of 142 pounds per square inch. When the intermediate cylinder was thrown out of action, the high-pressure cylinder exhausting into a receiver from which the low-pressure cylinder was supplied, the engine used 12.76 pounds of steam per indicated horse-power when developing 180 horse-power. The piston displacement of the high-pressure cylinder in this engine was less than one-sixth that of the low-pressure cylinder, which would be considered very poor practice when the customary ratio of three or four is considered. The engine obviously gave, when running compound in the way described, practically as high an efficiency as when running triple expansion, and therefore tended to indicate that compound engines are capable with different proportions of greater economy than they customarily give.

In the engineering laboratories of Sibley College a series of tests was recently undertaken to determine the relative efficiency of various groups of cylinders of the largest of the experimental engines. The cylinders were, first arranged to give the triple expansion engine in its usual form; second, the intermediate and high-pressure elements were combined to make a compound engine of the usual proportions, 3 to 1; third, the low and the high-pressure elements were combined to give a compound of the peculiar ratio of 7 to 1. The cylinders so grouped were of the dimensions 9, 16 and 24 inches in diameter, by 36 inches stroke. The curves of the steam consumption in the three different cases show a minimum for the compound engine—3 to 1—at 75 horse-power of 18 pounds of steam per hp hour. The triple expansion engine showed a minimum steam consumption at 113 horse-power, the steam per hp hour being slightly over 13 pounds. The compound, with a ratio of 7 to 1, showed a minimum between these two values, the steam consumption being less than 16 pounds per hp hour at about 125 horse-power. The curves ran up to a common point at about 37 horse-power, where all three combinations of cylinders required about 20 pounds of water per indicated hp hour.

Curves were also given showing the pounds of steam per brake hp hour, and the thermo-dynamic efficiency of the different groups of cylinders with different ratios of expansion. The triple expansion showed the highest economy with heavy loads, but its economy on low loads was less than that of either of the

others, owing undoubtedly to its greater friction losses. For the same reason the 3 to 1 compound shows at low loads a better economy than the 7 to 1 compound. The curves of steam per indicated horse-power with various ratios of expansion showed that the most economical ratio is about 12 for the 3 to 1 compound, and 21 for the triple, the value for the 7 to 1 being in the neighborhood of 17 expansions.

The designers of multiple-expansion engines, as a rule, attempt to so proportion their cylinders that the indicator cards reduced to a common scale and superposed will approximate as closely as possible to the ideal thermo-dynamic indicator diagram. For this reason they have so designed their cylinders that there should be practically no drop between the lower end of the expansion line and the back pressure. In engines of the new ratio, however, there is considerable drop from the high-pressure release line to the pressure of the intermediate receiver. This drop, while it cuts off a portion of the area from the indicator card, apparently improves the action in the low-pressure cylinder by its drying effect on the steam so that combined with the reduced size of the high-pressure cylinder for the same output of power, and the consequent reduction of cylinder condensation, the economy is improved. The conclusion was drawn by the authors of the paper that, wherever it was deemed advisable to use a compound instead of a triple-expansion engine, a considerable reduction in the size of the high-pressure cylinder below that customary would show a distinct improvement, especially on engines carrying variable loads.

The real desideratum in steam engine design in the great majority of cases, and particularly in the case of engines for electrical driving, is the design of an engine with which the cost of power throughout the whole range of working load shall be a minimum. This requires a greater consideration of the economy on low loads than is customarily given by the designers, who have become accustomed to the careful designing of engines for a minimum steam consumption under a considerable load. The cost of the added expense in attendance and lubrication of multiple cylinder engines must also be taken into account, the real end and aim of the purchaser and user of the engine being the amount of power obtained per dollar expended, including all the factors of first cost, maintenance, etc.

A New Determination, by Professors W. E. Ayrton and J. V. Jones, of the Value of the Ohm.

With the aim of obtaining a standard value of the unit of resistance, which value should not change with time, the machine known as the Lorenz apparatus has been developed. The British Government has adopted a standard known as the "Board of Trade Ohm Standard, Verified, 1894," which is a purely physical standard, the constancy of which, with time, depends on the assumed absence of any changes in its molecular structure or physical strains. The Lorenz apparatus depends upon the demonstration by the dimensional system, that a resistance is proportional to a velocity, and hence can be measured by standards purely of length and time, which are less likely to change in centuries to come than the physical aggregation of the molecules of any standard resistance.

The Lorenz apparatus, as built by Messrs. Nalder Brothers, of London, for the McGill University, of Montreal, consists of a bronze disc, mounted centrally on a shaft, by which it can be rotated in its own plane at high speeds, and concentric with this disc a solenoid surface in a helical groove of semicircular section cut in the cylindrical surface of a massive marble ring. This ring is about 21 inches outside diameter, 15 inches inside diameter and 7 inches in axial length.

The determination of the ohm involves the exact calculation of the coefficient of mutual induction between this coil and the periphery of the disc, and therefore involves the exact measurement of the diameter of the coil and disc. This was done with a Whitworth measuring machine, a long series of observations in different directions giving a highly accurate result. To prevent any leakage of current from turn to turn double silk-covered wire was used, brushed over with melted paraffin wax. The coefficient of linear expansion of the marble was also determined. The phosphor-bronze disc was ground in place, so as to be made true on its axis of rotation, and its diameter and coefficient of linear expansion were carefully measured.

Contact was made with the centre of the disc by a tube projecting into an axial hole in the disc and carrying a small stream of mercury. Three small tangential phosphor-bronze tubes were pressed lightly against the periphery of the disc at three points, separated by an angular distance of 120°. Mercury was passed through these tubes also, the effect being to greatly diminish the disturbances due to thermo-electric effects.

The method of determining the resistance was a zero method, the current in the field coil being passed through the resistance to be determined; and the E. M. F. set up in the disc at the proper speed, being balanced against the fall of potential in this resistance. For balancing an extremely sensitive Ayrton-Mather galvanometer of the d'Arsonval type was used. Extreme care was taken in the preparation of the resistance coils, their comparison with theBoard of Trade standard, and the determination of their temperature coefficients. The thermometers used in the investigation were carefully calibrated at Kew, and the clock which was used for the determination of the speed was combared with the time sent from Greenwich.

The results of successive measurements of the absolute resistances became very concordant after various possible causes of small errors had been gradually eliminated. Nine sets of observations taken on July 30, 1897, gave results for the value of the Board of Trade ohm in true ohms, which showed, when all corrections had been made, that one Board of Trade ohm = 1.00026 true ohms.

This result was then discussed in the light of all sources of error that could enter into it, and the effects that would be produced by such errors. The marble ring and the phosphor-bronze disc were carefully tested in induction balances for the presence of possible traces of iron which would affect their permeability, no such effect being detectable with a sensitiveness to one part in 15,000. The final conclusion of the series of tests was that the Board of Trade ohm is between two and three parts in 10,000 larger than the true ohm. This is probably the most precise comparison of physical standards of resistance with their defined value ever made.

The Tendency of Central Station Development.

II.—THE CENTRAL STATION PROPER.

As pointed out in the first part of this paper, the managers of lighting corporations are almost unanimously so changing their systems that their power can be generated in fewer and larger and more favorably situated plants. This change, combined with the natural growth of the cities and the increased use of electric light and power per capita, has caused a tremendous growth in the size of the stations. With those companies who have retained the older types of apparatus there has naturally followed a most bewildering complexity of station equipment that is undesirable in almost every possible way. Companies of more recent development, unhampered by the ownership of older apparatus, have constructed generating stations totally unlike those of the older types. In many stations there may be found side by side the small high speed belt driven inefficient generators of the past, and the large direct coupled slow speed machines of the up-to-date types.

The use of belts is now recognized as a relic of the past. Machines of all sizes from a few horse-power up, and for all purposes, are now to be obtained suitable for direct coupling to engines at either high, low or intermediate speeds. The Corliss engine, with which it was considered necessary a few years ago to use a jack shaft in order to obtain the necessary multiplication of speed for dynamo driving, is now direct coupled to the dynamo. The direct coupling of the high-speed engine and the dynamo was, of course, a more simple problem, the speeds of belt dynamos being not so very much greater than that of the engines. The latest developments, however, seem to favor the slow-speed direct-coupled dynamos for either railway, direct current lighting or alternating current work.

The development of the low-speed dynamo from the high speed has been effected in two ways; first, by increasing the diameter of the rotor, and second, by reducing the peripheral speed. The latter change, other things remaining the same, necessarily reduces proportionally the output of the machine, but as between the abnormal peripheral speeds used in the past and the improved speeds of the present it tends so to reduce the iron losses in the armatures that the induction can be carried much higher without impairing the efficiency of the machine. A great help in the same direction has also been obtained from the use of slot and tunnel armatures in place of the smooth core types. This change, which came so suddenly and so universally as to be almost a revolution, allows a much higher magnetization to be carried, owing to the reduction of the air gap to merely that necessary for safety against mechanical contact,

whereas, with the smooth core machines, the air gap consists of this safety gap in addition to the full depth of the armature windings and their insulation.

The reduction in speed has also been accompanied by an almost proportional increase in the number of poles, so that the frequency of the magnetic reversals in the armature iron has remained almost a constant. It is a great question whether this change has been for the best. In England the bipolar machine is still a great favorite, even for large units and low speeds, the number of lines cut per second by each armature conductor being as great with a bipolar construction as a multipolar—the induction per square inch remaining the same—and the hysteretic effects on the armature cores being less with the few than with the many poles. The construction of the commutator, particularly for high pressures, is also rendered a simpler problem with the fewer poles.

For systems using direct-current distribution there are two radically different types of alternating-current generators. One consists of the direct-current generator, designed for the voltage of the distributing system, and, perhaps, feeding the latter in the neighborhood of the generating station, the main output, however, being taken off by collecting rings and stepped up in voltage transformers to the proper pressure for the transmission lines. This type of generator obviously needs no separate excitation, and is of advantage where there is considerable load in the neighborhood of the station, or where it is desirable to equip the generating station proper with storage battery auxiliaries. The main difference between such a generator and standard low-pressure machines is that either the angular speed or the number of poles must be increased in order to obtain a frequency sufficient for economical transformation—the frequencies of from 8 to 16 cycles per second, which might be obtained from standard machines, being too low for this purpose.

The other type of generating machine is the more commonly accepted multiphase alternating machine, pure and simple. This type of machine requires separate excitation, and, for purposes of local supply, auxiliary transformation. It has the great advantages, however, that the current can be generated in the machine at full line pressure, and that the feature of the revolving armature and fixed fields necessitated by direct-current machinery can be departed from. Fixed armatures have already become the popular type in large alternating-current machines, the chief advantage being the relief of all centrifugal strains on the insulation of the active winding, and the consequent possibility of rendering the armature insulation sufficient for the direct generation of very high voltages.

Two types of such machines are almost equally favored; first, the inductor machines, and second, the machines with revolving fields and field windings. In the former the field winding, as well as the armature conductors, is stationary, and the machine can, therefore, be made with no collecting rings or brushes whatever. It has the disadvantage of a lower E. M. F. per turn, due to the non-reversal of the direction of the lines of force through the armature coils, the magnetization varying only between zero and a maximum instead of between two maxima, one on each side of zero. The reduced iron losses consequent upon this feature allow, however, of a higher magnetization being carried whenever a machine is serving a load which does not require, on emergencies, an extra high voltage. For machines which are occasionally called upon for extra high voltages due to heavy or inductive loads, or any other cause, it is obviously essential to have a reserve magnetization between that used in ordinary working and the maximum fixed by the induction curve of the iron.

Pioneer central stations largely favored high-speed engines, owing to the lower cost per horse-power and the ability to drive dynamos with one speed multiplication. The better economy of low-speed engines, with detachable cut-offs, favored their introduction where the cost of fuel was high. The low-speed engine required, as a rule, a double multiplication of the speed, involving an intermediate line shaft between the engine and the dynamo pulleys. This was readily made to serve as a sort of power trunk line, all the engines being belted to it with clutch pulleys, and all the dynamos from it in a similar manner. In this way any one or more of the engines could drive any one or more of the dynamos, the advantage of which is obvious. The failure of the line shaft, however, was with this arrangement calamitous, as it caused the shutting down of the whole system. With the modern direct-coupled machinery there is, as a rule, no possibility of any such intercommunicating connection between the engines and dynamos, although one interesting system has been developed by which the engines and dynamos are lined up on one shaft, the armatures being on quills, and clutch couplings being provided, by which any desired combination of steam and electric units can be obtained. This system, however, is difficult to install and particularly difficult to keep in accurate alignment.

Wherever the exhaust steam is not useful for heating purposes, the single-expansion engine is rapidly disappearing, being replaced by multiple-expansion engines, of which the compound is by far the most popular. Some stations, particularly those of the Edison type, use triple expansion and even quadruple expansion; but where loads are variable, the added economy of the third cylinder of the series appears hardly to pay for the increased cost and attendance. The cross-compound arrangement, with cranks set on "quarters," seems to be the most popular, the far greater uniformity of the torque with this arrangement being a great gain over that of the single-cylinder or tandem-compound engine.

Fly wheels have gradually grown heavier and heavier per unit output, the advantage of a large amount of stored energy being very great on sudden sharp peaks of the load curve. Fly wheels with a sufficient moment of inertia to carry the voltage of railroad generators over such sudden peaks are plentifully heavy to reduce the speed variation due to the intermittent pushes of a single-cylinder engine to a negligible quantity, so that in railroad work at least there is now no considerable advantage in the quarter-crank type. Cast iron is still the accepted metal for fly-wheel construction, although built-up wheels of boiler-plate steel are used at times. The advantage of the latter, in that they may be run at a much higher peripheral speed than the former with the same safety, does not seem to have been entirely realized. If this feature were taken advantage of, the steel wheel would be very little more expensive than the cast-iron wheel, storing the same amount of energy. Steam pressures have risen in central station work as everywhere else, the advantages of higher pressures being universally acknowledged. The disadvantages have largely disappeared with the more skillful construction of steam piping and the supply of cylinder lubricants suited for the higher temperatures involved. In the boiler rooms the high pressures have brought about the almost universal adoption of water-tube boilers. Vertical and horizontal engines are almost equally favored in point of popularity, the vertical marine type having a slight advantage in the largest sizes used. The advantage of the horizontal engine is its greater accessibility, its reduced liability of dripping oil and water over the generator, and the easier cushioning of its moving parts to prevent pounding at low loads. The vertical type requires less floor space than its rival, wastes less energy in internal friction, as its pistons and cross-heads are not dragged back and forth in a horizontal line, and requires also for the same reason somewhat less cylinder lubrication. When built with a single cylinder on each cross-head, it is very difficult to prevent the low-pressure cylinder from pounding, especially with a good vacuum, owing to the difficulty of getting anything to compress under the heavy piston. This is sometimes avoided by making the engine in a twin form, the high pressure and low-pressure cylinders being mounted steeple-like over each cross-head.

Report of the Pennsylvania Bureau of Railways.

In the report of the Chief of the Bureau of Railways for the State of Pennsylvania, covering the fiscal year ending June 30, the total capitalization of street railways in the State is given as $220,000,000. The operating expenses for the year are given at $10,000,000; dividends at $5,215,000. The report notes the influence of the bicycle on street car receipts, and advises legislation tending to the gradual abolition of grade crossings with steam systems.

Turning Laminated Cores.

Amateurs or experimenters who may have occasion to turn laminated armature cores, or to slot such cores on a planer where a milling machine is not available, will find that a strong solution of castile soap in water dropped on the tool will result in a clean cut without burrs.

DIGEST OF CURRENT TECHNICAL ELECTRICAL ARTICLES COMPILED FROM FOREIGN AND AMERICAN JOURNALS

BY CARL HERING

DYNAMOS, MOTORS AND TRANSFORMERS.

Determining the Compound Winding of a Dynamo. SHUELER. *Ele Zeit.*, Nov. 11.—A brief communication referring to the recent one by Fleischmann (see *Digest*, Nov. 13), describing a method which may be used when sufficient power is not at hand for running the machine fully loaded. He claimed that this method fails, because no account is taken of the shifting of the brushes, and that in every position in that test there would spark very badly. He recommends another method in which the machine is run at a fraction of its speed, say at one-tenth, the magnets, however, being fully excited; the test can then be made in the usual way, but requires only one-tenth of the power; as the magnetic relations are then the same as during the normal conditions, the sparking and the position of the brushes will also be the normal.

Tunnel Armatures. BAILEY. Lond. *Elec.*, Nov. 19.—A further communication forming part of the recent discussion on this subject. He replies to the criticisms of his recent article; he agrees with du Bois, but differs with Menges and Wilson in some respects; a diagram is given showing the way in which the mechanical drag is transmitted across the air gap, in which he considers the law of refraction of such lines.

Calculation of Dynamos. ARNOLD. *L'Elec.*, Nov. 13.—The beginning of a very full abstract, in French, of the German article noticed in the *Digest*, Dec. 19, 1896, Jan. 9 and 30, 1897; he describes a new method for calculating dynamos.

Twenty-five Years of Dynamo-Electric Machinery. EASON. Lond. *Elec. Rev.*, Nov. 24.—A short article describing the development of dynamos during the past twenty-five years. In 1872 the Gramme dynamo took practical shape.

Phase Transformer of Ferraris and Arno. LOMBARDI. *Elek. Zeit.*, Nov. 18.—The first part of a translation of a long paper from the Italian. The machine itself consists of a single-phase alternating current motor on whose stationary part next to the main winding are one or more systems of winding, in which the armature current induces E. M. Fs. whose amount and phase depend on the winding and positions of the coils. He discusses the theory of this machine, showing the mutual dependence of the different parts, and then giving the results of measurements which he made.

Transformers. SWINBURNE. Lond. *Elec. Rev.*, Nov. 12.—An article giving a brief history of the development of transformers during the past twenty-five years; the history of the transformer really began twenty years ago, when it was first introduced for commercial lighting in connection with the Jablochkoff candle, each lamp being put on the secondary circuit of a small transformer, the primaries of which were in series; in 1882 the Gaulard and Gibbs transformer was introduced.

Alternating Current Machines. FISCHER-HINNEN. *El'ty*, Nov. 24 and Dec. 1.—A translation of the article noticed in the *Digest*, Oct. 30, Nov. 13 and Nov. 27.

LIGHTS AND LIGHTING.

High Efficiency Incandescent Lamp. JACKSON. Lond. *Elec.*, Nov. 19.—A brief communication in which he states that he also made investigations some time ago in the same direction as Maxim and found that an addition of a small percentage of alumina increased the specific resistance of the material to be subsequently carbonized; the carbonization was made at the highest possible temperature, and there was no flashing or treating; the lamps so made were found to run some hundreds of hours at a mean efficiency of well below two watts per candle, without indication of blackning on the bulbs.

High Efficiency Lamps.—Lond. *Elec. Eng.*, Nov. 19.—A brief illustrated description of a new lamp which the Edison & Swan Company is placing on the market; it is designed to take only 2.75 watts per candle-power thus saving at least 25 per cent. of the energy; the life has not yet been determined, but it is expected to be 500 hours.

Twenty-five Years' Progress of Incandescent Lighting. SWAN. Lond. *Elec. Rev.*, Nov. 12; a reprint in *Elec. Rev.*, New York, Nov. 24 and Dec. 1.—An article giving a brief history of incandescent lighting, most of which dates after 1880; he gives as the probable number of incandescent lights in 8-cp equivalents, in use in different parts of the world, as not less than fifty millions.

Arc Lighting. CROMPTON. Lond. *Elec. Rev.*, Nov. 12.—An historical article showing the progress made since 1878, in which year he used the Serrin lamps.

Maxim Incandescent Lamp.—Elec. Rev., Dec. 1; *West. Elec.*, Nov. 27, and *Elec. Eng.*, Dec. 2.—A reprint of the letter noticed in the *Digest* last week.

POWER.

Electric Power in Shipyards.—Lond. *Elec. Eng.*, Nov. 19.—Abstracts of different papers, one by Westgarth describing the plant of a company in Middlesborough; another by Bigge on modern practice and electric power works; after enumerating the chief firms in the north of England who have adopted electric driving, he discusses the advantages and gives some general figures; the original paper contains a list of the powers absorbed by shipyard and other machine tools for running light and heavy, but unfortunately these are not given in the abstract; the discussion which follows contains nothing of special interest.

Electric Elevators and Cranes. RAVENSHAW. Loud. *Elec.*, Nov. 19.—The first part of a reprint of a recent paper read before the Institution of Civil Engineers calling attention to the electrical and mechanical problems involved, and describing methods by which they have been solved; some illustrations of the apparatus are given. It is somewhat elementary in character; he discusses the various elements involved and points out the usual practice; shunt motors are now almost always used; positive gearing is usual and worm gearing is generally adopted, the worm having a quick pitch; the arrangement used by the Otis Company is described and illustrated, and curves are given showing the energy consumed at different loads.

Transmission of Power. KENNEDY. Lond. *Elec. Rev.*, Nov. 12.—An article outlining the progress made during the past twenty-five years, dating from the discovery of the principle of the reversibility of the dynamo, namely, 1873; electric transmission of power was adopted in the sugar works at Sermaize, in France, as early as 1878, and was also extended to the working of mechanical ploughs.

Bellegarde. LEFEVRE. *L'Elec.*, Nov. 20.—An illustrated description of this 2000-hp water-power plant, including a table of the cost of the installation; an English description of this was noticed in the *Digest* some time ago, and it appears that some of the present information was taken from that.

Mechanical Transmissions.—L'Ind. Elec., NOV. 10.—A discussion, with some illustrations, of some friction and belt gearing for reducing the speed of electric motors.

Wave Motor. FLETCHER system. *Elec. Eng.*, Nov. 25; reprinted from *Industries and Iron.*—A description of one which has recently been tested experimentally; it is in the form of a cylindrical buoy; the action of the waves is used to create a hydraulic pressure. One of the small forms is illustrated, the equivalent head of water being 30 to 40 feet, and the energy being used to drive a turbine and dynamo for running a light which is said to be of far greater brilliancy than that of the usual gas buoys; with an apparatus weighing nearly 8 tons it is claimed that 600 incandescent lamps of 8 candle-power or 32 horse-power are generated.

Direct Connected vs. Belt Driven Generators.—West Elec., Nov. 27.—A brief account of some comparative tests which were made recently at Chester, Pa. A tandem compound condensing engine was directly connected to a 400-kw generator, running at 100 revolutions; in another test two condensing engines at eighty revolutions, were each belted to a 225-kw generator; the result showed a saving in coal of 22.7 per cent. in favor of the direct connected engine; the difference in the interest on the cost of the installation would be comparatively small, and would reduce this figure only about 7.5 per cent.

Comparative Costs of Steam and Electric Power. TAYLOR. *Elec. Eng.*, Nov. 25 and Dec. 2.—The first part of an article of a general character and giving hints concerning the best way to lay out a power plant.

Additions to the Niagara Falls Plant. DUNLAP. *West. Elec.*, Nov. 27 and *Elec. Eng.*, Nov. 25.—Brief illustrated descriptions of some of the recent additions; in the former journal he gives some notes regarding the Canadian power project.

Swiss Power Transmission Plants. SPENCE. *West. Elec.*, Nov. 27.—A reprint of the article noticed in the *Digest*, last week.

Rheinfelden.—West. Elec., Nov. 27.—An illustrated description reprinted from the *Sc. Amer.* of this plant, to which frequent references have been given in the *Digest*.

TRACTION.

Accumulator Traction. Epstein. Lond. *Elec. Eng.*, Nov. 19.—It is also reprinted without the discussion in the Lond. *Elec. Rev.* and *Elec.*, Nov. 19; a reprint is begun in *El'ty*, New York, Dec. 1.—The conclusion of the reprint of his paper (see *Digest*, last week) including the discussion. In the interests of economy the over charging which has so often been recommended should not be freely indulged in; the beneficial result is said to consist mostly in the fact that it thoroughly mixes the electrolyte. He then discusses the question of the cause of depreciation of the batteries; it may be reasonably expected that the useful lifetime is over 1500 discharges; the cost of renewing the positive plates is about 0.7 cents per car mile; with a good battery and the best suited conditions the working cost should be approximately the same as on the trolley system, the extra cost due to carrying the greater weight being balanced by the advantages. He then refers to carriages for ordinary roads; on good asphalt the tractive force should not exceed 60 pounds on the level; the weight of vehicle to carry two or four passengers, complete with motor and battery, would be about 30 cwt., of which 9 cwt. is battery; this should suffice for four or five hours, at a speed of 8 miles; the average effective horse-power would be about two on the level; the cost of the energy is about 1.5 cents per mile; they could, therefore, compete successfully with horse drawn vehicles; he questions whether a battery can be maintained at such a remarkably low rate as 10 per cent. per year. In the discussion one of the speakers gave some particulars about a new accumulator which is being tried in Dresden for tramways; the plates are pasted with the "ordinary salts" of lead; a cell weighs 13.5 kg. and the normal discharge is 65 amperes; they have run 130 miles without recharging. Manville, who had been connected with the Birmingham experiments, stated that the cost of renewals is not what makes the system uncommercial, as the real expense is not so much the accumulators themselves as that due to the effects they produce and to the handling of the cells, beside the large staff required; he believes the cells should certainly be carried independtly of the car; he recently made experiments with accumulators which were vibrated violently during discharge and found that they were no worse than those which were stationary; the "proportion of weight of cells in a tramway car is say, 1 to 3.5, but it is quite fensible to put a much heavier proportionate weight in light vehicles, say 1 to 2.75 or 1 to 3, and that difference will have great effect on life of cells." The discussion contains nothing further of importance.

Accumulator Traction at Ostende.—L'Elec., Nov. 13.—A brief, illustrated description of this line; it is 1.9 miles long; the batteries have a capacity of 140 ampere hours at 50 amperes; the car weighs 7500 kilograms without accumulators or passengers; on a new similar line, 15 miles long, at Gand, the weight of the accumulators will be about 2.5 tons; there are four cars; one charge will run 70 kilometers at 650 watt hours per car kilometer. During the past three months' trial it was found that the cost per car mile will be much lower than in any other system of traction; the amount of coal was 1.45 kilograms per car kilometer on the level; the draw-bar pull is 8 kilograms per ton for starting and 4 kilograms for running fully loaded at 18 kilometers per hour on the level.

Mechanical Features of Electric Traction. Dawson. Lond. *Elec. Rev.*, Nov. 19.—A reprint of a recent paper. He begins with a number of the tables of statistical data, chiefly for the United States, and then considers the subject of railways under the headings of outside work, rolling stock and power station, giving in each case practical data representing present practice; the article is of a thoroughly practical nature, and seems to contain useful information. The discussion is published in Lond. *Engineering*, Nov. 12, and appears to be merely of local interest; while due credit is given Americans, yet it is thought by some of the speakers that the English engineers could do as well.

Twenty-five Years of Electric Traction. Dawson. Lond. *Elec. Rev.*, Nov. 12.—An article outlining the progress made during that time; sixty years ago the first electric car was run, but it was not until 1879 that the first practical electric railway was laid; this was at the Berlin Exhibition; the first commercial line was built at Lichterfelde, near Berlin, in 1881, by Siemens & Halske; two years later a road was built in England, and it is said to be still operating successfully. He also indulges in some speculations concerning the possibilities of the future.

Electric Traction on Steam Roads.—Elek. Zeit., Nov. 18.—A note stating experiments are in progress on the Hungarian Government railroads, with a view to changing from steam to electricity for the passenger service; at present electricity will be used only on some of the shorter lines, and the cars will be operated by accumulators; the material has been ordered, and it is thought that the preliminary tests will be made in the spring.

Three-Phase Traction.—L'Ind. Elec., Nov. 10.—The beginning of an illustrated article on the plant at Neuchatel, the length of which is about 3 miles; the system proposed will be to use triphase currents of 4,000 volts which are transformed into continuous currents at 550; accumulators are also to be used, as it was estimated that with a greater cost of insulation the operation would be better.

High-Speed Railroad.—Lond. *Elec. Rev.*, Nov. 19.—A brief description of the Behr system which has been in use at the Brussels exhibition; the car is said to run very satisfactorily, and it is claimed that a speed of 100 miles an hour has been obtained; the running of the carriage is universally admitted to be much easier than on the ordinary railway; the car has run about 2000 miles up to the present.

Fly Wheels for Traction Plants.—Lond. *Elec.*, Nov. 19.—An editorial calling attention to a recent statement by Raworth, to the effect that the less fly wheel the better, referring to engines in power houses for traction; he claims that it is the cause for all the sudden and severe shocks to which such an engine is subjected; the suggestion is discussed and criticised, and it is shown that there must be some storage of power, and it is a matter of detail whether it is in the form of a battery or a heavy fly-wheel.

Switch Panel for Railway Tests.—Lond. *Elec. Rev.*, Nov. 19.—An illustrated description of a switch panel devised by Elliott Brothers as a standard for the Board of Trade tests; the tests required are described, and are followed by the suggested arrangement of instruments to carry them out.

Conduit Road in Brussels.—Elek. Zeit., Nov. 11.—An illustrated description of the conduit lines referred to briefly in The Electrical World last week; the illustrated description of the conduit is reproduced in the Lond. *Elec. Eng.*, Nov. 19.

Conduit Railway. Lachmahn system. *L'Elec.*, Nov. 20.—A brief illustrated description showing the construction of this system as it has been finally adopted; it will be remembered that it has been in experimental use at Hamburg.

Electric Boat Propeller.—Lond. *Elec.*, Nov. 19.—A note mentioning a new development; it consists in an attachment to any ordinary pleasure boat rigidly connected with it and containing the accumulator and switch gear; it appears that it also contains the motor; the vibration is said to be perceptibly less than in one containing a motor; it is thought that there is a considerable loss in efficiency.

Boat.—Elektrochem. Zeit., Nov. 1.—The results of some measurements made with a boat equipped with electric accumulators and in use at Hamburg.

Electricity for Trunk Lines. Hutchinson. *West. Elec.*, Nov. 27.—An abstract of this portion of a recent discussion at the New York Railway Club. He does not believe that improvements and advances made during the last fifteen years have materially advanced the electric motor in this branch of service; he thinks much harm has been done by the indiscriminate praise of the third-rail system.

Conduit System in Washington. Hopkins. *Elec. Eng.*, Dec. 2.—A very brief, illustrated description of the methods which have been adopted by the Metropolitan Railroad in Washington for changing its cable system into a conduit electric system.

Portable Railway. Koppel system. *Elec. Eng.*, Nov. 25.—A reprint, with illustrations, of the article referred to in the *Digest*, Nov. 13.

Electric Launch.—Elec. Rev., Nov. 24.—A reprint of the short, illustrated description referred to in the *Digest*, Nov. 13.

Elieson Carriage.—Elec. Eng., Dec. 2.—A reprint of the description noticed in the *Digest*, last week.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Distribution of Electrical Energy. Wordingham. Lond. *Elec. Eng.*, Nov. 19.—A continuation of his paper (see *Digest*, last week). He continues the discussion of net works, with special reference to the one at Manchester, of which an illustration is given. He then discusses the systems of mains to be used and the relative advantages of the drawing in and of the built-in systems. A reprint is begun in the Lond. *Elec. Rev.*, Nov. 19, and in *El'ty* (N. Y.), Nov. 24 and Dec. 1.

Proper Choice of the Best System.—Elek. Zeit., Nov. 18.—An editorial discussing the question of the determination of the best system to be used for a central station. Generally the conditions are such that several systems would be about equally advantageous, and a careful investigation should therefore be made to determine which of them is the best, and in doing this it is well to consider what has been done in other cities; an extract is then made of a recent report by Lindley and others for a proposed plant for the city of Mannheim, which is said to be very instructive. Although the district is so small that a 110-volt continuous current system could be used, they nevertheless recommend a three-phase system with substations; the question of power for industrial purposes and for traction had to be considered as the amount of power was nearly equally divided among them; they recommend a single generating station located on the river; the distribution is to be from the secondary net work, the primary voltage will be 4000; ultimately it is thought the three-phase current will be used directly for traction, but at present the continuous current is to be used, being obtained from rotary transformers located in different parts of the city; booster batteries are also to be provided for; some of the more important date is given.

Substitutes for Pilot Wires.—Lond. *Elec. Eng.*, Nov. 19.—Replies to a question whether there is any reliable method of indicating at the station end, the voltage at the distant end of the feeder, without the use of pilot wires. Markland states that there is no absolutely accurate method; a

method, though not used very much, is to employ a combined transformer in which the secondary coils are opposed to each other; the primary of one is in shunt across the two mains and therefore the secondary voltage is proportional to the bus-bar pressure; the primary of the other is in series with the feeder, and consequently the E. M. F. is proportional to the current. Locke describes a method of using two transformers with the volt meter in series with their secondaries; the primary of one is connected across the mains and that of the other in series with the mains, the secondary being shunted by an adjustable resistance; if one be made to oppose the other the voltmeter reading will indicate the actual pressure at the far end.

Systems of Charging. CLAUDE. *L'Ind. Elec.*, Nov. 10.—A long article in which he discusses the methods of charging, pointing out the great importance of finding the best one. The Wright and the Hopkinson methods are discussed and the advantages of the former are pointed out, remedies and improvements being suggested; he concludes that there should be a charge which is progressively reduced with the increase of the amount of power, and that the price of the energy should decrease with the co-efficient of consumption; the application of the system which he proposes is claimed to be at least as simple as the present one, over which it has advantages.

Capital per Kilowatt.—Lond. *Elec. Rev.*, Nov. 19.—A reprint of a short table giving the capital per kilowatt for the principal London central stations; it varies between $440 for the St. James and Pall Mall station to $1135 for the Notting Hill station; a financial paper claimed that this should be the governing element from the investors' point of view; this is followed by a smaller table giving the last dividend paid by each of those companies on the ordinary shares, from which the utter fallacy of this claim is shown.

Central Stations. HAMMOND. Lond. *Elec. Rev.*, Nov. 12.—A historical article showing their development in the United Kingdom, where the first central station was constructed in 1878; it refers largely to his experience; he concludes with a tabular statement of the financial progress during the past twenty-five years, limiting himself to those stations which are working under the electric-lighting act; the figures in the table begin with 1882; the total number of stations for the present year is estimated to be 122, the total number of lamps in 8-cp equivalents is about 5,000,000, and the total capital invested is about $57,000,000.

Multiphase Work in the United Kingdom.—Lond. *Elec. Rev.*, Nov. 12.—Illustrated descriptions of the installation of multiphase machinery made by an English company. It appears that the use of multiphase machinery is controlled by the Tesla patents in that country and the fact that so little machinery of this kind is in use there, is said to be due to this; the model station described is claimed to be equal if not superior in arrangement and soundness of design, to any installation in that country.

Alternating Currents. MORDEY. Lond. *Elec. Rev.*, Nov. 12.—An article entitled "1831–1872," in which he describes the development and the practical use of alternating currents prior to the period twenty-five years ago. Excepting voltaic applications, he states that alternating currents have considerably greater claims than direct currents to be considered the older of the two; they were originally applied forty years ago for lighthouse purposes.

Flushing.—Elec. Eng., Dec. 2.—A brief illustrated description of this small light and power station, the design of which was claimed to be as difficult as that of a large station.

Compact Isolated Plant. LEWIS and CHAFLIN. *Elec. Eng.*, Nov. 25.—A brief, illustrated description of a small private plant which was constructed under severe conditions.

Rand.—Elec. Eng., Dec. 2.—A brief illustrated description of the central station in this city in the Transvaal.

WIRES, WIRING AND CONDUITS.

Switches and Fuses for Concentric System.—Lond. *Elec. Eng.*, Nov. 19.—Replies from Fenell and from Pilling, to a question whether switches and fuses should be placed on both poles of the secondary of a transformer, the primary of which is fed through concentric cables the outer side of which is grounded. The former states that the low-tension circuit must be considered entirely distinct from the other, and that it therefore is equally important to have fuses and switches on both poles of the secondary, whether one pole of the primary is earthed or not; Pilling, on the other hand, claims that fuses and switches should be placed only on the inner pole of the secondary when the secondary mains are of the concentric type, the reasons applying equally well to these and to the primary.

Safe Carrying Capacity for Electrical Conductors. WEST. *Elec.*, Dec. 2, and *Elec. Rev.*, Dec. 1.—A reprint, in abstract in the latter, and without the illustrations, of a recent paper read before the Chicago Electrical Association. He discusses the general physical laws and conditions, and gives a summary of numerous articles which have been written on the subject, including data which may be of use.

Test of Insulated Wires. STONE and WEBSTER. *Elec. Eng.*, Nov. 25.—A reprint of a table giving the results of insulation tests which have been made once a month for the past ten months with wires bought in the open market and which were approved by the underwriters; they were allowed to lie in water all the time; the names of the makers of the wires are not given.

Defects in Designing Electrical Specialties. GARDNER. *Elec. Eng.*, Nov. 25.—An article calling attention to defects which he observed in some of the ordinary appliances used in wiring, most of which could easily have been remedied by the manufacturers if a little more attention had been given the subject.

Underground Circuits for Arc Lighting. SHARPSTEEN. *Elec. Eng.*, Dec. 2.—Descriptions of some experiences which he has had; he claims that circuits can be placed underground without going to exorbitant expense.

ELECTRO-PHYSICS AND MAGNETISM.

Coherer. SWINTON. Lond. *Elec.*, Nov. 19.—A short communication calling attention to the sensitiveness of a coherer made of carbon powder, such as is used in modern telephone transmitters; he found it quite sensitive; in the long-distance transmission of Hertzian waves he found that conducting mains, and even single copper wires placed quite out of the direct path between the transmitter and receiver, and even behind the latter, have a powerful effect in arresting the response to signals; he suggests that the indifferent results obtained with reflectors for receiving and concentrating the waves may be due to this effect, their damping action being more injurious than their reflecting power is beneficial.

Physics. APPLEYARD. Lond. *Elec. Rev.*, Nov. 12.—An article on "Twenty-five Years' Experiments in Physics," in which he outlines the work done during that period, much of which is in other branches than the electrical.

Screening by Luminous Gases. WIEDEMANN and SCHMIDT. *Wied. Ann.*, No. 11; abstracted briefly in the Lond. *Elec.*, Nov. 19.—They demonstrate the existence of the absorption by luminous gases of the radiations which make them glow.

Canal Rays. WIEDEMANN and SCHMIDT. *Wied. Ann.*, No. 11; abstracted in the Lond. *Elec.*, Nov. 19.—They studied the Goldstein first cathode layer, and canal rays, with an improved apparatus.

Discharge Rays. HOFFMANN. *Wied. Ann.*, No. 2; abstracted in the *Elektrochem. Zeit.*, Nov. 1.—He made researches to determine the properties of these rays; the conclusions are given in the abstract, but are too numerous to be given here; among others he states that some substances have the property of changing these into Röntgen rays.

Magnetic Test for Iron. DUANE. *Wied. Ann.*, No. 11; noticed briefly in the Lond. *Elec.*, Nov. 19.—He discovered the true source of his so-called new magnetic effect in the presence of extremely minute admixtures of iron in the specimens of sulphur and other dielectrics with which he experimented.

Magnetism. JAMIESON. Lond. *Elec. Rev.*, Nov. 12.—A short article on twenty-five years' developments in magnetism, pointing out the principal advances made in the study of this branch of electrical science.

Gold Foil Screens for X-Ray Work. WOODS. *Elec. Rev.*, Dec. 1.—A long communication concerning X-ray burns and the efficiency of gold foil for preventing them, as was suggested by him; he defends himself against the criticisms of Thomson (see *Digest*); he considers it of vital importance to connect the screen to the earth; it should also be large enough to protect the rest of the body; he believes the charge imparted to the body is an important factor in the protective action. He describes one of the numerous carefully made experiments which he has conducted.

X-Ray Tube. ROLLINS. *Elec. Rev.*, Dec. 1.—An illustrated description of his tube, in which the anode is kept cool by a stream of water behind it.

Röntgen Society.—Elty. Nov. 24.—A reprint of a brief newspaper report of the first meeting of this society in England.

ELECTRO-CHEMISTRY AND BATTERIES.

Modification of the Lelande Battery.—L'Ind. Elec., Nov. 10.—A brief description of a modification suggested by Boettcher, who makes oxide of copper in an agglomerated form in which it readily reoxidizes in the air; in the usual form there is difficulty in reoxidizing the copper; the consumption in such a battery is said to be about 1.2 to 1.25 grams of zinc and 4 to 6 grams of soda per ampere hour; the voltage soon falls to 1.85; the measurements of a cell containing 200 grams of caustic soda are given for two discharges showing the capacity to be from fifty-three to sixty ampere hours; the solution can be regenerated by treating it with sulphide of sodium.

The Primary Galvanic Battery. GATEHOUSE. Lond. *Elec. Rev.*, Nov. 12.—An article outlining the progress in primary batteries made during the past twenty-five years; in the introduction he states that they stand in almost the same position now as they did then.

Coal Gas Battery. BORCHERS. *Elek. Zeit.*, Nov. 11.—A reprint with illustrations of the article which was abstracted in the *Digest* Aug. 21; see also Sept. 18.

Light Accumulator. PESCETTO. *L'Ind. Elec.*, Nov. 10.—A description, with the illustration, of his battery-plate, for which he claims great lightness. After discussing the subject of lightness, which may refer to the energies stored, to the power in watts per kgr. or to the amperes per kgr. for the charge, and showing that these sometimes conflict, he describes

his plate, which it appears consists merely in cutting into the bars of an ordinary grid plate with a penknife in such a way that little pointed pieces are formed which may be bent over the pellets of active material so as to keep them from falling out. He also recommends the use of a material obtained by treating sugar with sulphuric acid. At a discharge of 4.6 amperes per kg. of plates and a slow charge, he obtains 26 watt hours per kg.; for nearly double this discharge rate following a rapid charge, the output was 6.8.

Accumulator Construction. FitzGerald. Lond. *Elec. Eng.*, Nov. 19.—In this instalment of his serial he continues the descriptions of the processes for forming lead plates or depositing the active material on them.

Machine for Making Accumulator Plates.—Elektrochem. Zeit., Nov. 1.—An illustrated description of a machine for rapidly casting complicated forms of accumulator grids; 600 can be cast in ten hours.

Twenty five Years' Progress in Secondary Batteries. Epstein. Lond. *Elec. Rev.*, Nov. 12.—An article outlining the growth of the electrical accumulator, including a reference to the recent application for traction.

Electro-deposition of Zinc. Cowper-Coles. Lond. *Elec. Rev.*, Nov. 19.—Illustrations of plates on which zinc has been deposited, showing that it appears to be the presence of free acid which accelerates the formation of the zinc sponge, which is the chief difficulty attending the electric deposition of the zinc; moreover the anodes appear to be incapable of keeping the solution up to its original strength.

Carbon Electrode. Hertel. *Elektrochem. Zeit.*, Nov. 1.—An illustrated description of his new electrode for strong and continuous currents; it appears to consist in boring numerous holes lengthwise through the plate, inserting copper tubes which fit the holes closely, and in these copper strips, the space being filled with the depolarizing mass, such as copper oxide or pyrolusite, the copper strips acting as conductors for taking off the current.

Electro-chemistry and Metallurgy. Andreoli. Lond. *Elec Rev.*. Nov. 25.—An article outlining the progress in this field during the past twenty-five pears.

Electrolytic Soda.—Lond. *Elec.*, Nov. 19.—A note stating that a large French company has been formed at Grenoble for working the Hulin process, which has been in use for some time on a small but industrial scale at Modane with sufficient success to warrant the construction of a larger plant. In this process fused lead is used as the cathode and fused salt as the electrolyte; it is a modification of the Vautin process; a 5000 hp water power is to be used, and it is expected that the plant will be in operation early next year.

Ionization and Osmotic Pressure. Traube. *Wied. Ann.* No. 11; abstracted in the Lond. *Elec.*, Nov. 19.—He advocates "some rather daring and revolutionary ideas" concerning electrolytic dissociation and the kinetic theory of liquids.

Chemical and Electrochemical Theory. Mewes. *Electrochem. Zeit.*, Nov. 1.—A second instalment of his theoretical articles. (See *Digest*, Sept. 25.)

Chemical Action of Electrical Oscillations. Hemptinne. Lond. *Elec. Eng.*, Nov. 19.—A brief abstract of the article noticed in the *Digest*, Oct. 30.

Thermo-Electric Batteries. Anthony. Reed. *Amer. Elec.*, Nov.—Anthony asserts that some of the oxygen forced into the Jacques cell goes into solution, or in some other way comes into electrical connection with the iron electrode, combines with the positive ion in strict accordance with Faraday's law, and is the medium by which the current reaches the iron electrode and so passes out of the cell. He states that Reed in his argument has omitted this union of oxygen with the positive ion. Reed replies that he has pointed out the source of energy furnished by the union of oxygen with the positive ion, which, however, is not a source of electricity but a source of heat. He states that the only possible sources of energy in the Jacques cell are the energy of carbon oxidized within the cell, the heat energy evolved within the cell by the oxidation of reduced ions, and the heat energy absorbed from without; the first of these is insufficient to cause decomposition of the electrolyte and hence cannot evolve, but must necessarily absorb electrical energy; the external source of energy is excluded by hypothesis, and there is left no possible source of current except thermo-electric inversion. Criticising a reaction given by Anthony for the Jacques cell, he says that if the evolution of electrical energy depended upon such a reaction, the weight of potassium hydrate used would be 9.33 pounds for every pound of carbon consumed in the cell, which, he remarks, would be a rather expensive method of getting electricity direct from carbon.

Electro-chemical Progress. Blount. *El'ty*, Dec. 1.—A reprint of the article noticed in the *Digest*, last week.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Contact Surfaces for Amperemeters. Troll. *Elek. Zeit.*, Nov. 11.—An abstract of a recent lecture in which he discussed the subject of the proper size of the surface of contact in the terminals of large amperemeters, with special reference to the instruments made by a German firm. On the assumption that the heat at the contact should not raise the temperature more than 50° C. above that of the surrounding air, he states that for 1000 amperes the contact surface should be 1810 sq. mm; some central stations formerly required 3 to 5 sq. mm per ampere; the curve which he gave, but which is not reproduced, consists of two parts, the first from 1 to 2500 corresponds to 4 sq. mm per ampere, and the second part from 3000 to 6000 amperes to 3 sq. mm per ampere; the Weston curve has a number of corners, and for 1000 amperes corresponds to about 2 sq. mm per ampere. For the larger currents the contact surface is made cylindrical, the bolt itself being used for that purpose, it being possible to make a very good fit with cylinders.

Meters. Brillie system. Lond. *Lightning*, Nov. 18.—An illustrated description of this meter, which it is claimed avoids most of the evils pointed out in the recent discussion on the subject. It starts with a very small current, absorbs very little power, is easily adjusted, remains constant, and cannot be started without a current; it is an energy meter, and there is no need to compensate for friction, as this does not affect the accuracy of the instrument. It consists essentially of a coil of fine wire suspended obliquely within two stationary coils carrying the main current, and will thus be deflected, which closes shunt circuits through a small motor and through the coil itself; to the coil is attached a copper cylinder suspended between the poles of permanent magnets, which latter are rotated by the motor, and in turn tend to rotate the coil in the opposite direction to that in which it is deflected; the coil thus acts as a governor to the motor, which latter is connected with a numerical recording gear.

Permanence of Resistance Coils. Crawley. Lond. *Elec.*, Nov. 19.—A communication on the recent article by Ayrton; he claims that Ayrton overstated the evils of the coil of wire standard very much; coils which are to be used as real master standards are most carefully treated; those tested have a very different history as they have traveled about extensively; he is not satisfied that these coils are necessarily altered at all; the error found could be caused by an error in the temperature of one-twelfth of a degree centigrade, and it is therefore within the limits of errors of observation; he recommends some more scientific ultimate standard.

Determination of the Ohm. Ayrton and Jones. Lond. *Elec. Rev.* and *Elec. Eng.*, Nov. 19.—A long article describing the determination which they made in testing the Lorenz apparatus for the McGill University; the apparatus and the very carefully made measurements are described.

Clark Cells. Spiers, Twyman and Waters. Lond. *Elec.*, *Elec. Rev.* and *Elec. Eng.*, Nov. 19.—A brief abstract of a Physical Society paper on the variations of the E. M. F. of the H-form of cells with temperature. They investigated how nearly the true E. M. F. can be computed at different temperatures by applying the ordinary correction; they made a careful study of the lag behind the temperature; the results are given in curves (which are not reproduced); they show that the lag in that cell is less than in the Board of Trade form; under ordinary conditions and with a variation of temperure of less than 2° C. per hour, the true E. M. F. can be computed for the H-form, within a ten-thousandth of a volt; in this respect there is little to choose between the H-form and the Muirhead cell.

Absolute Measurements. Gray. Lond. *Elec. Rev.*, Nov. 12.—An historical article pointing out the work done in absolute measurements and its effect on the advances in practical electricity in the past quarter of a century. Twenty-five years ago the British Association system of units had just taken shapes; he considers the greatest step in the advance made in the determination of the ohm was that made by Lorenz when he invented his disc method in 1873; he discusses also Maxwell's magnetic theory of light and the work done in determining specific inductive capacities.

Instrument Making. Price. Lond. *Elec. Rev.*, Nov. 12.—An article describing the general course of progress in electrical instruments during the past twenty-five years.

Resistance Determined by Screening Effect. Erskine. *Wied. Ann.*, No. 11; abstracted briefly in the Lond. *Elec.*, Nov. 19.—He determined the specific resistance of various electrolytes by the screening effect produced by a layer of the electrolyte in the path of electric waves, which screening is proportional to the thickness of the layer and the conductivity of the electrolyte.

Permanency of Resistance Coils. Ayrton. *El'ty*, Nov. 24.—A reprint of the article noticed in the *Digest*, Nov. 27.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Wireless Telegraphy. Slaby. *Elek. Zeit.*, Nov. 11; abstracted briefly in the Lond. *Elec.* Nov. 19.—A short abstract of a recent lecture. He uses the terms "Funkentelegraphie," meaning spark telegraphy, in place of wireless telegraphy, and "Fritter" or "Frittroehre" for coherer. From his systematic researches he found that trees, buildings, hills, etc., appreciably affect the propagation of the electric waves, especially when they are near the wires of the transmitter or the receiver; the length of the charged wire is of great importance in the length of the distance of transmission, while the height is of less importance; the wires can even be laid horizontally, but the height should be sufficiently great because if too near the earth even at only one place the action is almost entirely stopped; for the least distance should be two meters; from every point on each wire the whole of the other wire should be visible; dust interferes very greatly with the transmission; he believes that with further development of the apparatus the distance of transmission may be 200 to 250 times the length of the wires; he obtained better results by using very thin, well-insulated

wires of small electrostatic capacity; the atmospheric electricity is a very important consideration; he also made the observation that wires in the neighborhood, and in the same direction as the waves are propagated, very greatly increase the distance of transmission; over a wire it is therefore possible to telegraph simultaneously by two different methods, with the electric current as usual, and with the waves.

Wireless Telegraphy. BENEST. Lond. *Elec.* and *Elec. Rev.*, Nov. 19.—A communication calling attention to a patent to Edison in 1892; he describes the system briefly; the transmission is by means of induction between two elevated plates, such as at the top of ship masts; a secondary circuit of an induction coil is connected between the plate and the ground; the receiver is an electromotograph; this anticipates Marconi's suggestion to use high vertical wires.

Submarine Cables for Telegraphy. BRIGHT. Lond. *Elec. Rev.*, Nov. 12.—An article on the construction; laying and repairing of submarine telegraphs, in which he outlines the progress made in the last twenty-five years. No radical change of the cardinal principles of submarine cable construction has occurred during this period; steady improvements in materials and details are alone the characteristics experienced, a summary of which he gives,

Telegraphy. PREECE. Lond. *Elec. Rev.*, Nov. 12; reprinted in the *West. Elec.*, Nov. 27.—A short article outlining the progress made during the past twenty-five years. In 1871-2 and 1896-7 the number of telegrams which were sent over the Postal wires were about 10,000,000 and 80,000,000 repectively; the number of offices 3500 and 8282; the wire mileages about 95,000 and 290,000; the number of instruments 8945 and 30,132, the latter being made up as follows: Automatic, 436, quadruplex, 137, multiplex, 31, repeaters, 131, sounders, 4735, Morse printers, 739, Hughes, 77, Bright's Bell, 952, single needle, 4724, A B C, 5018, telephones, 8843, and miscellaneous, 4319. In 1872 the speed was 100 words a minute, and now 600 has been obtained in practice.

Twenty-five Years' Progress in Military Telegraphy. VON FISCHER-TREUENFELD. Lond. *Elec. Rev.*, Nov. 12.—An article showing the development of military telegraphy; the first introduction of the telegraph in war was at the siege of Sebastopol in 1854; a submarine cable was then also used for the first time as a military line.

Printing Telegraph.—Lond. *Elec.*, Nov. 19.—An illustrated description, including a diagram of the connections, of the "zerograph" of Kamm. The most important claim is the absence of clockwork; a synchronizing device is used; the speed is claimed to be far beyond that of the step-by-step types; it is claimed that twenty-five words per minute can be transmitted; it prints on tape, but a column printer has also been devised.

Use of Electricity on Railroads. LANGDON. Lond. *Elec. Rev.*, Nov. 12.—An article outlining the various uses of electricity in connection with steam railroads during the past twenty-five years. Regarding its use for traction to replace steam he admits that there may be a great future, but that it can hardly be said to have begun yet; he gives special attention to the railroad telegraph, block signalling, and train and station lighting.

Prevention of Induction in Telephones by Railways.—Lond. *Elec. Rev.*, Nov. 19.—A note describing a plan which was adopted with more or less success; it consists in insulating the subscriber's earth connections wherever it has been thought likely that they will be in contact with the return rails, and at the same time insulating these rails from the earth; the method used in Brussels consists in employing a common return wire of low resistance for all of the subscribers; this should have the same capacity and self-induction as the line wire, the diameter and length being the same; it has been found necessary in that case to use an automatic device to change the earth return for the wire return when unhooking the receiver, in order to prevent other subscribers' bells from ringing.

Telephone System. WEST. *Elek. Zeit.*, Nov. 13.—A description, illustrated with diagrams, of a system in which a number of telephones can be connected to the same wires, only one of them having a call bell, and in which when one is in use the others will be automatically disconnected, which is done by means of a lever which locks the telephone hook; it is of use for the case in which there are a number of telephones in convenient places in a building, each of which are to be connected through the main telephone to the central station, but they cannot be called; the instrument with the bell is the main one connected with the central station.

Overhead Wires for Telephony. WEST. *Elek. Zeit.*, Nov. 11.—A continuation of his long serial (see *Digest*, June 5), in which he describes, with the aid of illustrations, some of the more important features in the construction of such lines and supports in foreign countries.

Telephony. KINGSBURY. Lond. *Elec. Rev.*, Nov. 12.—An article outlining the development in telephony since 1876.

Telephone Exchange System.—Elec. Eng., Nov. 25.—A brief, illustrated description of the "private branch telephone exchange" service in New York City; by means of a switchboard at the subscriber's end any one of a number of 'phones in his building can be connected with the exchange.

MISCELLANEOUS.

London Electrical Review.—The Nov. 12 issue of this journal is a specially large number, marking the close of the twenty-fifth year of that journal's existence, the first number having been issued Nov. 15, 1872. It contains a large number of articles by prominent writers on twenty-five years' progress in various branches of electrical engineering; these articles are referred to in the *Digest* under their respective headings. A brief history of that journal is given in an editorial; its weekly issues began in January, 1882. One of the articles by Mordey gives some interesting notes on the first volume of that journal; among the matters pointed out are that in the first number there is described and illustrated a machine that would now be called an inductor alternator; also the first description of the Clark cell, while the second number contains an account of the Planté battery.

Diagram Accounts. JAMESON. Lond. *Engineering*, Nov. 12.—A reprint in full, with the diagrams, of the recent paper which was noticed in the *Digest* last week; the discussion is reprinted in another part of that issue. The Lond. *Elec.*, Nov. 19, contains a long abstract of the paper.

Electro-therapeutics. HEDLEY. Lond. *Elec. Rev.*, Nov. 12.—An historical summary of the subject of electro-therapeutics, showing the progress during the past twenty-five years; in 1872 electro-therapeutics was steadily advancing on sound lines; he closes with a section on Röntgen rays in surgical and metallurgical work.

Gas Lighting System.—Elek. Zeit., Nov. 11.—An illustrated description of the Klinger system of simultaneously lighting a large number of gas flames by a simple system; it is accompanied by a number of illustrations.

Asbestos. SHILLING. *Elektrochem. Zeit.*, Nov. 1.—A short article on this material, stating that it is now made so that it is not affected by alkalies, chlorine or acids.

Testing Ship Models. PRICE. *Elec. Eng.*, Nov. 25.—A short article describing the method adopted by the Government for testing the speed of small models of ships, the apparatus for which is under construction at the Washington navy yard. Railway motors on a track will tow small models of ships through the water, the force exerted being measured; the maximum power will be about 100 horse-power.

Testing India Rubber Goods.—Elec. Eng., Nov. 25.—A reprint from *Engineering*, referring to rubber in general and without any special reference to that for electrical purposes.

American Electrical Work in Europe. PORTER. *Elec. Eng.*, Nov. 25.—An abstract of the paper noticed in the *Digest*, Nov. 27.

Book Reviews.

LUCE E RAGGI RONTGEN, del Professore Oreste Murani, con prefazione del Professore R. Ferrini. (Light and Rontgen Rays, by Prof. Oreste Murani, with a preface by Prof R. Ferrini). Paper, Quarto, 392 pages, 15 tables and 157 illustrations. Published by Ulrico Hoepli, Milan.

This interesting work treats of light and the phenomena of electrical oscillations, phosphorescence, fluorescence and the conditions obtaining in vacuum tubes, as well as of the extraordinary phenomena of X-rays, from a purely physical point of view. It is non-mathematical in character.

ELECTRIC SMELTING AND REFINING; THE EXTRACTION AND TREATMENT OF METALS BY MEANS OF THE ELECTRIC CURRENT. Being the Second Edition of Elektro Metallurgie, by Dr. W. Borchers. Translated, with additions, by Walter G. McMillan, Lecturer on Metallurgy in Mason College, Birmingham. J. B. Lippincott Company, Philadelphia; Octavo, cloth; 415 pages; 3 plates; 188 illustrations. Price, $6.50.

This English translation of Dr. Borchers' well-known manual is an excellent and faithful piece of work. The practical applications of electrometallurgy are advancing with phenomenal rapidity, and the appearance of this really valuable book at this time should be the means of doing much to assist this. An excellent index adds greatly to the value of the work.

PRACTICAL ELECTRICITY IN MEDICINE AND SURGERY. By G. A. Liebig, Jr., Ph. D., of Johns Hopkins University, and G. H. Rohé, M. D., of the College of Physicians and Surgeons, Baltimore. Philadelphia and London: F. A. Davis, publisher.

This book was written with the view to set forth in a concise way, for the benefit of medical students and practitioners, the fundamental principles of electricity and its practical applications in medical and surgical work. It is a handy volume of 378 pages, divided into three parts. In the first part are considered electricity and magnetism in general, and the various forms of electrical and magnetic apparatus likely to be of use to the physician, including the battery, the galvanometer, the electric motor, the telephone and the phonograph. The second part deals with the effects of electric currents upon the various tissues and organs of the body in health and disease, and the appliances most useful in electro-therapeutic work. The third part is devoted to the special applications of electricity in the treatment of disease. The language throughout is clear and to the point, and the work is profusely illustrated. The aim of the authors to make this a trustworthy guide for the student and practitioner is fully accomplished.

INTERNATIONAL TEXT BOOK OF MEDICAL ELECTRO-PHYSICS AND GALVANISM. For the use of medical students and practitioners. By William J. Herdman, Ph. B., M. D.; Henry McClure, M. D.; J. Mount Bleyer, M. D.; A. Wilmer Duff, M. A., B. Sc. (Edin.); George J. Engelmann, M. D.; Albert P. Brubaker, M. D.; Frederick Peterson, M. D.; Wesley Mills, M. A., M. D., L. R. C. P. (Lond.), F. R. S. (Can.). Philadelphia: The F. A. Davis Company, publishers. London: F. J. Rebman.

This is a work of nearly 400 pages, written by nine well-known experts, designed, as the title implies, for the use of medical students and practitioners.

The introductory chapter is by Dr. W. J. Herdman, of Ann Arbor, Mich., who writes on the necessity for special education in electro-therapeutics; A. Wilmer Duff, B. Sc., of Lafayette, Ind., contributes a long chapter on electro-physics; Dr. Wesley Mills, of Montreal, contributes a short article on animal electricity; Dr. Henry McClure, of Cromer, England, writes on static electricity and magnetism; Dr. G. J. Engelmann, of St. Louis, on the faradic or induced current, electro-magnetism, electro-massage and instruments; Dr. J. Mount Bleyer, of New York, on galvanism; Dr. A. P. Brubaker, of Philadelphia, on electro-diagnosis, and Dr. Frederick Peterson, of New York, on cataphoresis, anodal diffusion, electrical osmosis, or voltaic narcotism. Each author deals with his subject in a thorough and masterly manner, cuts being freely used for purposes of illustration. It is safe to say that the book will be highly appreciated by the medical practitioner.

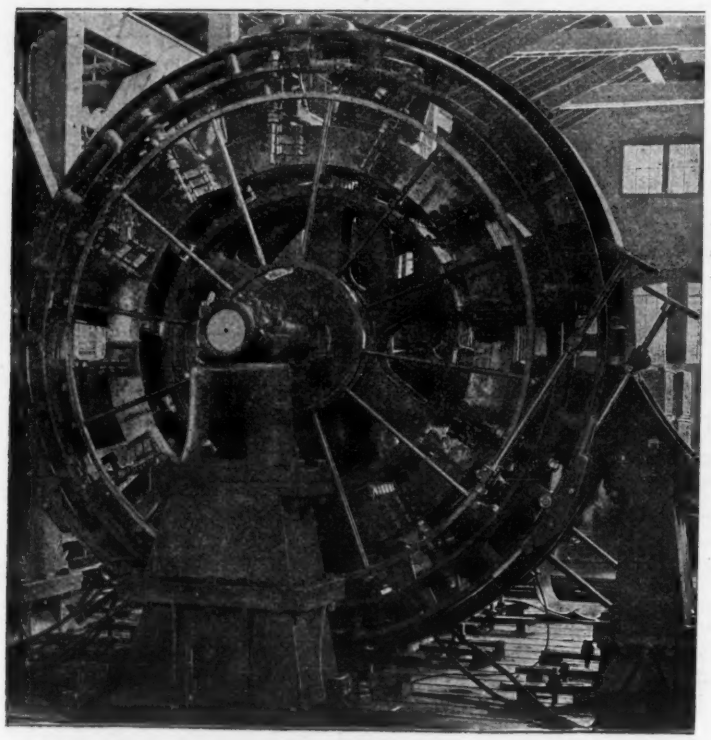
Smooth Body Generator.

An addition to the lighting portion of the station of the Edison Electric Illuminating Company, of Paterson, N. J., will shortly be made in the shape of two 200-kw, ten-pole, 150-revolution, smooth-body, General Electric lighting generators. These will furnish current to the Paterson company's already extensive three-wire system, and when installed will give it a total generating capacity for lighting purposes of 1400 kilowatts in direct connected apparatus of the General Slectric Smooth-body type. The feature of these machines which has given them their name lies in the armature, which is built up of a laminated soft-steel core without teeth, having the coils in the shape of rod or pressed stranded conductors connected by end bars forming the surface of the commutator, which is on the vertical face of the armature, and has, of course, as many segments as the armature has coils. The adoption of this method of construction saves losses due to resistance in commutator leads and segments, and is of importance in generators of low potential with large current output. The large number of segments reduces the volts per bar to a minimum, and renders them absolutely sparkless, while the vertical commutator permits of the inspection of all the brushes at once. The brush holders are so arranged that by one hand-wheel they may be simultaneously shifted or by another all raised at one time from the fact of the commutator. The illustration given below shows one of these smooth-body generators in process of construction in the works of the General Electric Company at Schenectady

Automatic Focusing Photo-Engraving Lamp.

The rapid development of the photo-engraving art is no doubt due largely to the continued improvement in the construction of electric focusing lamps. The lamps have been passing through the developing stage, but have reached a high degree of perfection, and it is now possible to obtain such lamps so reliable and uniform in their operation as to leave little more to be desired.

The Manhattan General Electric Company, New York, has entered the field of competition for this class of trade with an automatic focusing photo-engraving lamp which is said to give satisfactory results in actual service. During the past three years the Manhattan Company has recognized a demand for a lamp constructed on substantial lines that would burn at any angle, give a steady light without sputtering, and, at the same time, eliminate spots and shadows. Such a lamp is shown in the accompanying illustration. This lamp is recommended by the Manhattan Company as one that will meet every requirement in photographic and blue print work. As it weighs only 40 pounds it can be easily moved about. It can be operated singly or two in series, on direct-current 110 or 220-volt circuits.

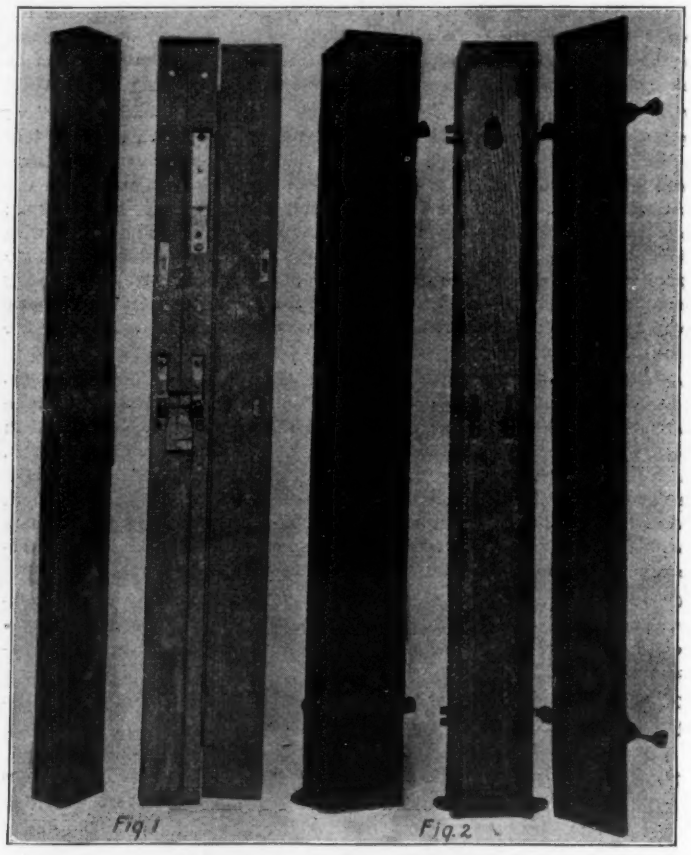


Smooth Body Generator in Process of Construction.

Focusing Lamp.

Excessive Current Recorder.

It is well known that considerable power is wasted in the operation of electric railways by the improper manipulation of the controller, and to check this waste is the object of the device illustrated herewith. Another practical result of the use of the excessive current recorder, besides checking the needless waste of current, is the reduction of the expense for motor repairs, which is a natural consequence of the better control of the power.



Excessive Current Recorder.

This device gives street railway managers a direct measure of the heat being generated in the car motors above a certain specified amount. The recording device proper consists of a German silver wire between the two terminals, *A* and *B*, shown in the illustration. The main car circuit is through this wire, which is of a certain size for any given service and weight of car, so that when the motorman uses current in excess of what he needs to enable him to make a trip on time, the temperature of the German silver wire increases to such a degree that it will melt its way through the strip of alloy against which it rests. The strip of alloy is 17 inches long, and 3¼ inches wide, and the hot wire simply melts its way through the middle of the strip, according to the amount of current used in excess of requirements. The recorders are given out to the motormen either locked or sealed, and are placed by them in iron recorder cases, with which each car is equipped. Each motorman is furnished with a recorder when he takes his car, and at the end of the run he returns the same to the office.

Contact switches are provided on the back of the recorder cases, which close the circuit through the recorder when the instruments are being placed in the cases.

It is stated by the use of this instrument the average power required to operate a road may be reduced from 10 to 20 per cent., and the equivalent of this in terms of fuel may be readily calculated by any manager. The strain on the motor equipments by the excessive flow of current is also reduced by the use of this device, since the motorman, knowing that there is a check on his operation of the controller, will exercise greater care in the use of the current

These recorders are made by the Cravath Manufacturing Company, 825 Monadnock Building, Chicago, Ill., in a very substantial manner, and are in every way fitted for the hard usage of electric car service.

The Manufacture of Armature Discs.

The extensive introduction of the electric motors and dynamos for power and lighting purposes in mills and factories has created a large and increasing demand for special tools and machinery for the accurate and economical production of the various parts entering into their construction.

One of the most important of these parts is the armature disc. The needs of the trade in this connection demand many different-sized armatures, which has consequently developed several distinct methods for making the discs or "punchings" from which laminated armatures are built up.

Recently this subject has become one of great importance, and an outline of the various methods employed to produce the discs possesses at present a considerable interest. We consequently illustrate several modern machines specially adapted for this work, which have been designed by the E. W. Bliss Company, Brooklyn, N. Y.

For such discs as are made up in large quantities, and which are of a moderate diameter (for street car motors, for instance), the general method of manufacturing is by the use of dies and power presses of the type shown in Fig. 1. These presses are fitted with tools so arranged that the inside of the disc, with its key slot, and the outside, with its notches (Figs. 2 and 6), are cut simultaneously with one stroke of the press. This constitutes the quickest and most economical method, but on account of the great expense involved in the tools it is applicable only where large quantities are needed. The presses required to operate these dies are provided with knock-out attachments, which discharge the outside scrap and disc so as to lay loose on the top of the dies, whence they may be quickly and easily removed, but the stock cut from the centre and bolt holes falls through the die.

The above-mentioned method of manufacture also applies to sections as shown in Figs. 3 and 4. Some sections have their plain outside cut first and are perforated or notched in the second operation.

In the case where very large diameters or relatively small quantities are required the cutting of the outside and inside circle is done in shears of the type shown in Fig. 5. The lower cutter of this shear being in an angular position permits of making as clean a cut on the inside as on the outside of the disc. The machine is perfectly accurate, and is built much stronger than other shears for this class of work. The key notches on discs made in this manner are usually slotted after the discs (Fig. 6) have been together, by means of a vertical slotting machine. Discs with small centre holes (Fig. 7) may have the outside cut in a shear and the centre punched in a small power press.

When plain discs are first cut out and have to be notched either on the outside (Fig. 2) or inside (Fig. 8) the notching is done in another machine. In

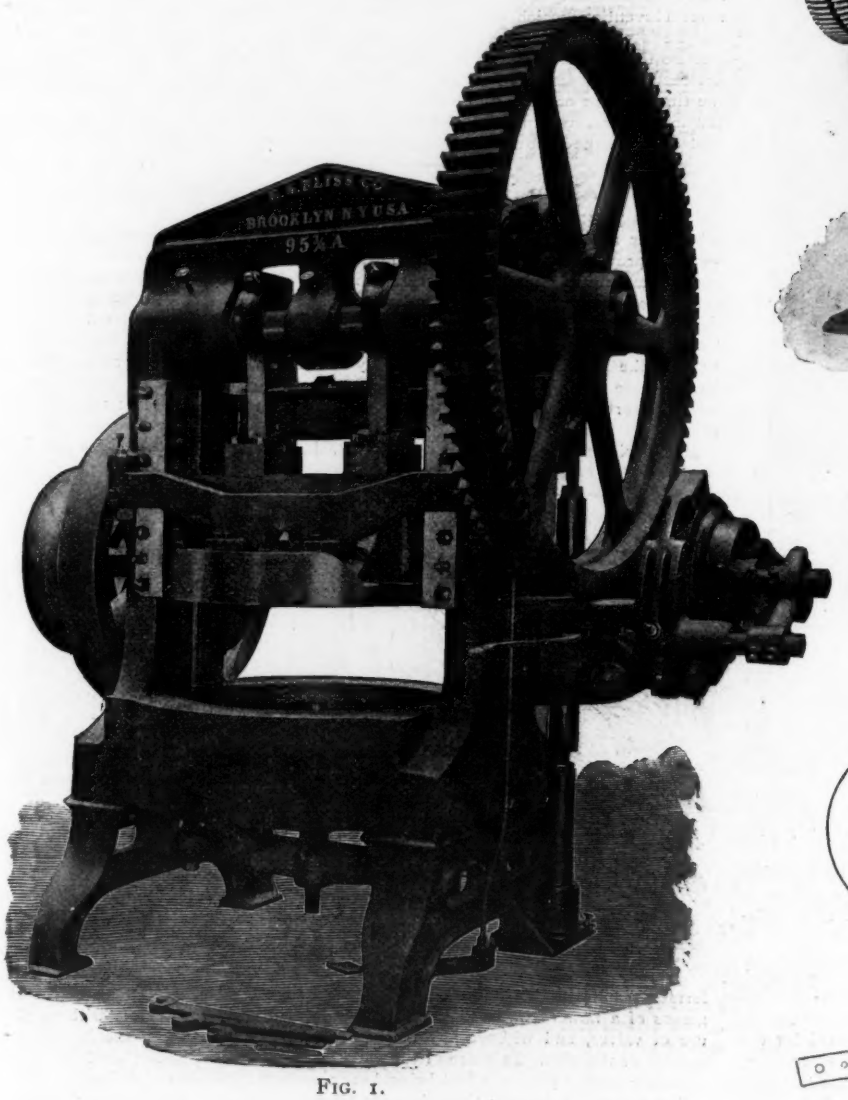


FIG. 1.

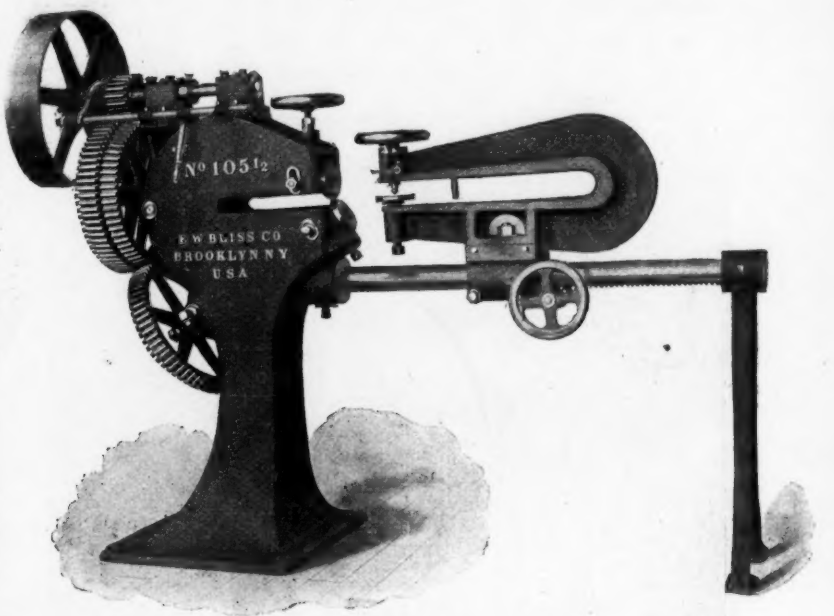


FIG. 5.

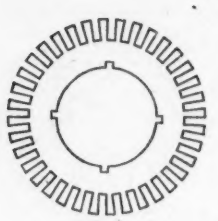


FIG. 2.

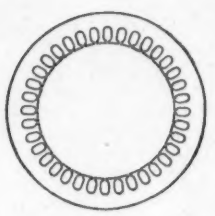


FIG. 8.

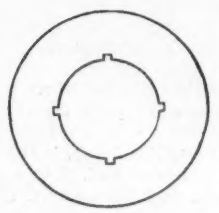


FIG. 6.

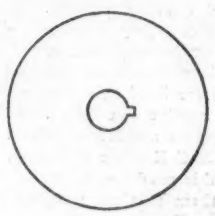


FIG. 7.

FIG. 3.

FIG. 4.

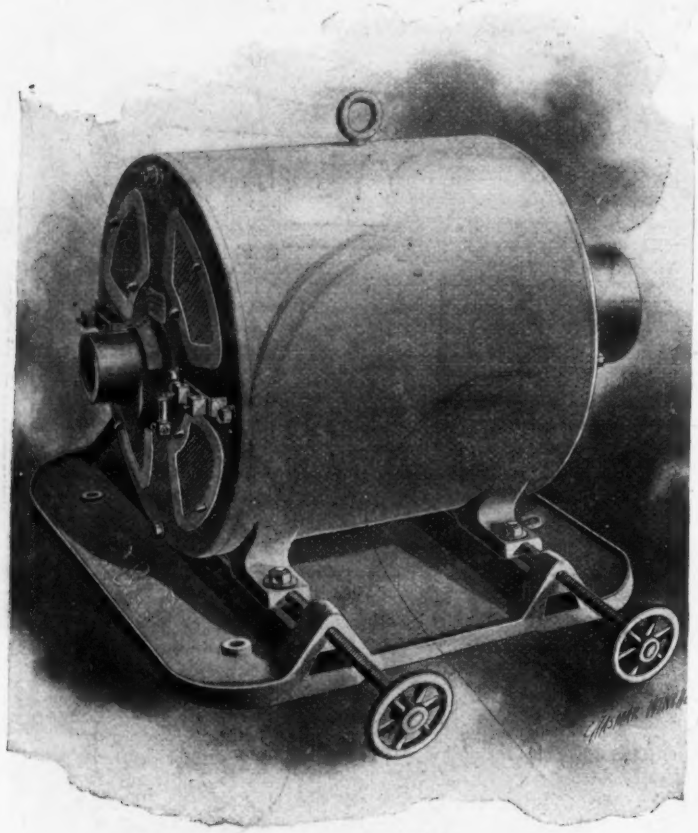
case of such polyphase-motor discs as have motor discs, the holes or notches punched at the inner periphery, it is necessary to do the notching before the large inner circle is removed, as its surface is needed for carrying the disc in notching. One or two of the small holes are usually punched in that portion of the disc, which is subsequently cut away in order to serve as guides in the notching and centre-hole punching machine. For work of this kind the notching machine must be provided with a clamping arm.

Open Ironclad Motor.

The motor illustrated herewith is of a type which possesses many advantages, in that it may be placed in any horizontal position and bolted either to the floor, wall or ceiling by slight adjustment of the end plates, and consequently of the oil wells. It may be direct connected to the line or machine shaft, or back geared for any desired speed reduction, in which latter case bracket bearings are bolted to the frame of the motor. While not entirely inclosed, the design and construction is practically the same as that of the C & C closed type ironclad motor, the main difference being that in the open type shown herewith brass frames fitted with brass wire mesh serve for hand-hole covers instead of the cast-iron covers employed in the entirely closed machines.

The magnetic field frame, on account of its peculiar construction, serves as a case in which all working parts, the windings, brush holders, etc., are confined. It is of cast steel, and the pole pieces are cast integrally therewith. Each of the two cast-iron circular end plates is bolted by four bolts to the frame, and is fitted with self-oiling and self-aligned bearings. The brush holder spider is clamped upon a shoulder upon the front end plate.

The machines are of the four-pole type, and the pole pieces are fitted with



Open Ironclad Motor.

shoes of a special design and material and are bolted to the poles in a decidedly novel and effective manner. The coils are wound on non-combustible spools and are thoroughly insulated. The armature is of the drum type, the form-wound coils being placed in slots in the periphery of the armature. The carbon brush holders are of the C & C reaction type.

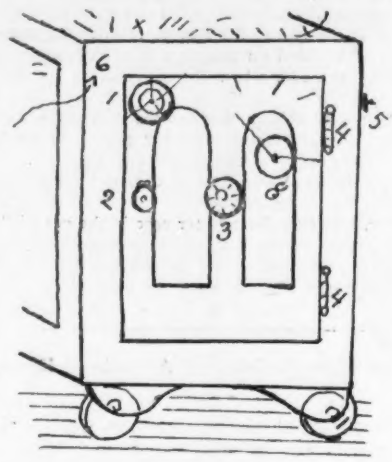
This motor is of such design that it is especially adaptable where a motor is liable to receive but little attention, as all its working parts are entirely protected against accidental injury.

The C & C Electric Company, 143 Liberty Street, New York, is the manufacturer of this machine, which is supplied as a dynamo as well. The company is making them in sizes ranging from 4 kilowatts, or 5 horse-power, to 30 kilowatts, or 35 horse-power.

Opening Safes by Means of the Electric Current.

Since the first announcement that the electric current might be used for the purpose of opening safes many arguments have been advanced by electricians and safe makers to prove that such a method of gaining access to the inside of a safe or vault was not practicable. Experiments, and one actual case, have, however, demonstrated that there is nothing to prevent the successful use of electric current for such a purpose, when safes or vault doors have become locked through defective mechanism or by accident. It is evident, also, that a burglar or any evil-minded person may utilize the same agency in a like manner if he is so disposed and has the opportunity.

Mr. J. H. Howard, advisory engineer of the Moss Safe Company, Boston, Mass., states that he has successfully penetrated solid steel with the ordinary Edison incandescent light current, and is ready to demonstrate the practicability of this agency to any bank which may find itself "locked up" accidentally, or to anyone who is seriously seeking the truth and facts. Mr. Howard states that any steel door, 4 inches or under in thickness, can be opened in less than an hour; that cast or chilled iron safes, either square or round, are much more vulnerable than those made up of laminated welded tool steel and iron, or Bessemer steel plates, and that the chill or temper can be readily drawn from drill-proof metal by the application of the electric current used in business buildings. Banks, however, he states, need not despair, since devices and



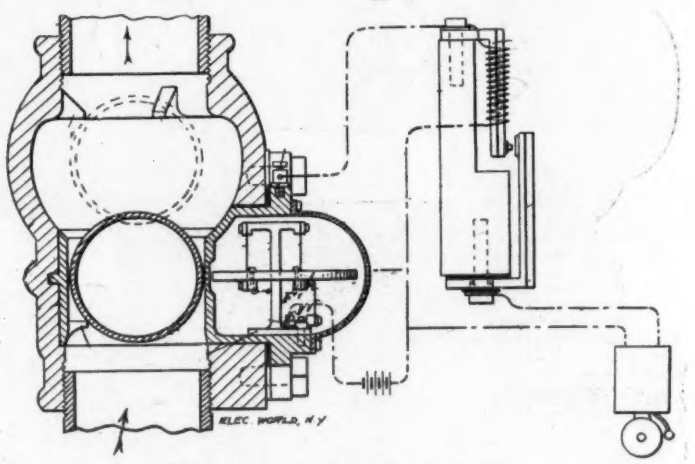
Opening Safes by Means of Electric Current.

modes of construction have been invented to overcome this menace and neutralize this new danger, both on old as well as on new work. Mr. Howard has made several inventions which suggest various methods of accomplishing these results, and he is prepared to show means of insulating the locks and locking mechanisms so that old work can be made proof against this mode of attack. Checking devices are also perfected so that even if a hole is melted through a door and the time lock or combination lock driven off, the bolt work will still be held in the locked position and the door remain closed and intact. This is a matter that deserves the serious attention of every bank in the country.

Alarm for Automatic Sprinkler Systems.

That the automatic sprinkler systems as a means of extinguishing fires is of value is proved by its extensive application, and while its use for many years stricted largely to mills and factories it is now almost the rule to find such an installation in large stores and warehouses. The additional advantage of providing an automatic alarm in connection with the operation of the sprinkler system has long been recognized, but difficulty has been experienced in the past in putting the idea into practical form. By reason of variable water pressure false alarms were liable to be turned in. Another cause of false alarms was the use of some sort of a valve in the supply pipe, which was troublesome to keep in repair.

Mr. Orville Carpenter, of Pawtucket, R. I., recognizing the deficiencies in



Mechanism of Sprinkler Alarm.

former results in this direction, has devised a method of giving an alarm by means of a flow of water in the supply pipe of a sprinkler system without the use of valves, and without any mechanical connection between the inside and outside of the pipe. In place of the valve, a hollow iron ball is placed inside of the main supply pipe, the ball being heavy enough to readily sink in the water. Being somewhat smaller than the pipe, it can be freely moved by the upward pressure of the water. The ball is supported by lugs projecting from the walls of the pipe. On the outside of the pipe and directly opposite the centre of the ball, is a permanent steel horseshoe magnet suspended to move easily, and so placed that its poles are drawn against the outside of the brass pipe by the proximity of the iron ball inside. Whenever the water in the pipe moves up-

ward it carries the ball with it, thus taking the latter out of the field of the magnet, which is then drawn back a short distance by the action of a spring. This movement of the magnet completes an electric circuit in which is included a bell or other indicating device, which may be located at the nearest fire station, or wherever else desired. It will be readily seen that when the water in the supply pipe moves, by reason of the opening of a sprinkler by fire or accident, the alarm will be sounded.

This invention is said to be practical and reliable. The first device ever made after these plans has been attached to a sprinkler system in a factory nearly four years, and, although it has never been altered, repaired or changed in any of its parts during that time, it is still in perfect working order. It was crudely put together in the first place, but that the apparatus is operative and reliable is evident from the above-mentioned facts. The invention is applicable in many other ways, wherever it is desired to give an alarm or indication of the flow of a liquid, or even gas, or the cessation of flow of either, no matter how great the distance.

Mr. Carpenter has just been granted a United States patent on this invention, which is also secured by a British patent.

An English Enclosed Arc Lamp.

The continuous-current inclosed arc lamp long since passed from the experimental stage of its development into the commercial world as a reliable and successful apparatus, and it has grown rapidly in favor everywhere on account of its economies and other electrical and mechanical advantages. The problems involved in the production of an equally successful inclosed arc lamp for alternating currents have not, however, been so easy of solution. The peculiar difficulties met with in the use of these currents for arc lighting have constituted the principal obstacles to the development of such a lamp, but that these are being overcome is evident from the fact that lamps of this character are now on the market and offered to the trade and users as being reliable and satisfactory in operation.

In England the subject of inclosed arc lamps is also receiving the attention that its importance demands, and two English electricians, Messrs. W. J. Davy and G. Thomas-Davies, have recently perfected lamps of both classes, which are reported to have given very satisfactory results in practical operation.

A description of these lamps, which possess in their design and construction some novel ideas and features, will no doubt be of interest to our readers.

The alternating inclosed arc lamp (see Figs. 1 and 2) is designed to run on 4 to 12 amperes, with a pressure across the arc of 65 to 70 volts, at all frequencies. The series wound lamp will run on 100-110-volt mains, without choking coils or resistance, when the frequency exceeds 83 cycles. The lamp will run for ninety hours, the arc being drawn, usually, to a length of one-half inch. Two lamps may be run in series on 200-volt mains. In construction they are somewhat different to the continuous-current lamp, although in general principle there is a close resemblance between the two types.

Fig. 1 shows the controlling solenoid, and Fig. 2 shows the core, the solenoid

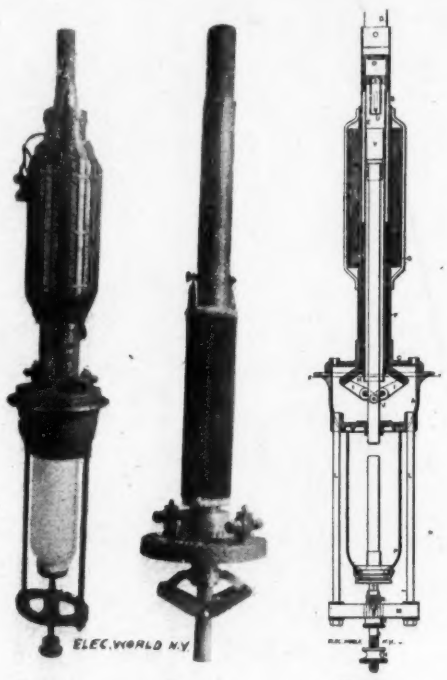


FIG. 1. FIG. 2. FIG. 3.

and the lower portion of the lamp having been removed. In the latter illustration the clutch is also shown. The action of the mechanism is the same as that in the continuous-current lamp, a cross-sectional view of which is shown in Fig. 3. The latter lamp is constructed for from 2 to 8 amperes, and is wound either shunt, series or differentially, to run either in series or parallel. The voltage at the arc ranges from 65 to 75, the usual length of the arc being three-eighths of an inch. Both carbons are solid, and, usually, of 13 mm diameter.

Referring to Fig. 3 an iron casting, *A*, is secured into a cover, *C*, which carries the terminals, the suspension arrangement being attached to an insulating plug, *D*. Within the tube *B* slides, with clearance, another tube, *E*, to which is attached the annular iron core *F* of the iron-clad solenoid *G*. Attached to the lower end of the tube *E* is the carbon-gripping device *H*, which acts on the toggle principle. The parts *I I* are linked together, but to nothing else, at *J*, so that the whole grip is free to rise or fall with the core, till, in falling, when it rests on the bottom of the chamber *A*, the carbon is released and fed. Secured also to the casting *A* are two rods, *L*, which carry the frame *M*. This frame supports the lower carbon holder and the inner globe *P* by means of a hollow screw, *R*, which screws up through the arm *S*. The moving tube *E* carries an air dash-pot, *O*, to damp its motion. Current passes to the upper carbon through a flexible cord attached to the carbon holder *V*.

In the alternating-current lamp the core of the solenoid is built up with soft charcoal iron laminations. It slides outside of the frame tube and actuates the inner grip controlling tube, through the medium of a transverse pin. The action of the lamp is as follows: The current in passing through the lamp energizes the series coil, which draws the core up into it, by this action raising the grip device. As the grip leaves the bottom of the chamber *A* the upper carbon is gripped between its jaws and is lifted, thus striking the arc. To feed the carbons together it is simply necessary that the pull on the solenoid shall have decreased sufficiently to allow the grip to be lowered to the bottom of the chamber, when the carbon is released.

It is stated that these lamps are being used with satisfaction in the electric light and power station at Havre, France. In a recent test one of these lamps was run on a constant-pressure alternating-current circuit in series with a choking coil, the frequency of alternations being 50 cycles per second. The voltage across the arc was 68, the arc itself exceeding one-half inch in length. The current through the arc was about 8½ amperes. Photometric measurements on a horizontal plane passing through the arc gave 357 candle power, the corresponding consumption of power being 540 watts. Reduced to units this represents a consumption of about 1.51 watts per candle. At 45° to the horizontal plane photometric measurements gave a candle power of 420, with the same consumption of energy, corresponding to 1.28 watts per candle. The light was steady and well diffused.

Street Car Lamps.

The important feature in lamps intended for use on railway circuits is long life without decrease in brilliancy. To secure this, both mechanical strength and uniformity of product are essential. Railway lamps should be uniform, not only in size, shape and appearance, but absolutely so in current consumption. Both length of life and sustained candle-power depend upon such uniformity, and while the former is the most desirable characteristic, it should not be forgotten that lamps are primarily made to give light. Practically any length of life can be securer in lamps of low efficiency—lamps consuming a large amount of power; but power is not had for nothing, and while one lamp may last longer than another it may consume so much current as to make it cost more than a lamp of shorter life, consuming less current. Furthermore, a lamp may have a very long life, and yet be so dim as to make it worthless—consuming current

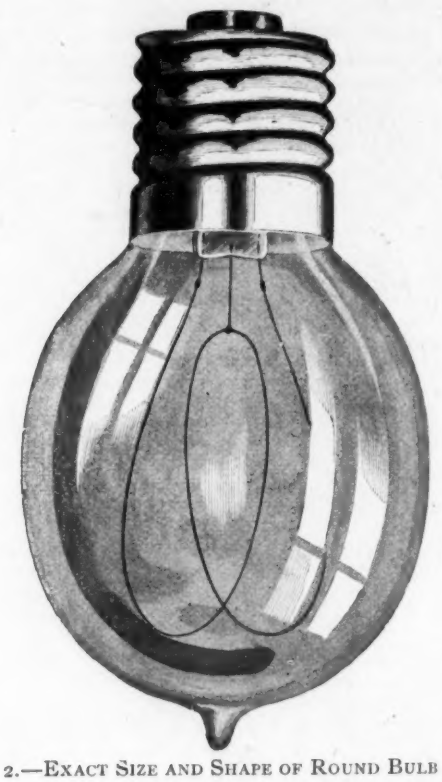


FIG. 2.—EXACT SIZE AND SHAPE OF ROUND BULB LAMP.

without giving a proper return in light. The ideal lamp, therefore, is that in which the average life is combined with average candle-power and energy consumed to give the best lighting service for the least cost, including lamp renewals and power consumed.

In the Edison railway incandescent lamp the results above mentioned are said to be obtained, first, by its mechanical strength, the filament, of cellulose, with a hard graphite carbon coating, being so shaped and anchored as to protect it, as well as the bulb, from injuries likely to occur from the vibration and shock inseparable from street car service. The anchoring of the filament is essential. An unanchored filament must necessarily be so stiff and short as to limit the light to a small area. This reduces both the efficiency and sustained brilliancy of the lamp. The position of the anchor is also of importance. To anchor the lower end of the filament to the inside of the bulb is objectionable. The filament

is held too rigidly, exposing both it and the anchor to rupture in case of jar or shock. Rigidity can be eliminated by loosely resting the filament in the loop of the anchor, but the friction of the filament in the loop quickly wears it away. In the Edison lamp the anchor is set in the stem, and the vibration of the filament is rather checked than entirely prevented. It is thus not strained nor weakened, as both filament and anchor vibrate together, and no chance exists of the branches interlocking and short circuiting, as would probably be the case if one loop of the filament were anchored to the side of the bulb and the other left free to vibrate and strike against it.

As railway lamps are operated in series, the current capacity should be uniform. Edison railway lamps are therefore made in three different classes—for 500-volt circuits, for 550-volt circuits and for 600-volt circuits—in each class the lamp being selected for a given amperage. The standard railway lamps have an efficiency of 4 watts per candle at full 16 candle-power. They are fitted with the standard Edison screw base, or with bases to fit almost any make of socket. Fig. 1 shows the standard Edison railway lamp—exact size and shape.

For the decoration of cars or for headlights, or special locations in which a small, compact bulb is required, the round bulb lamp is manufactured. Its filament is shaped and anchored, as is the standard railway lamp, and both are furnished frosted, or of almost any desired color—either artificially dipped or in natural glass. Fig. 2 shows the round bulb lamp—exact size and shape.

Improved Evaporation Water Cooler.

With the earliest development of the steam engine, the advantages of condensing apparatus, by which the back pressure on exhaust could be reduced by 12 to 14 pounds, have been well recognized. In fact, the earliest engines were condensing engines, the steam gauge pressure being zero pounds; in other words, the boiler pressure was the same as atmosphere, the total force on the piston being due to this steam at atmospheric pressure on one side and the vacuum produced by the condenser on the other. Until recently it has been almost unquestionably considered that a source of cold water was necessary for cooling the condenser, and thereby liquefying the steam. With engines located where such a source of water was unavailable it has been considered that atmospheric exhaust was imperative. During the last few years, however, it has come to be recognized that there are other ways of disposing of the heat of the exhaust steam besides throwing it away as warmed water.

The evaporation water cooler, designed by Mr. E. F. White, is a complete and thoroughly worked-out apparatus for the accomplishment of this purpose, and is now being placed on the market by M. T. Davidson, 43-53 Keap Street, Brooklyn, N. Y.

This cooler consists fundamentally of a series of vertical multi-concentric galvanized spiral-riveted tubes extending from a common headway at their top to a water receiving chamber at their lower ends. The water used for condensing purposes is introduced into the annular space between these tubes at their tops at a slight pressure (about 2 pounds) through a distributing head, which gives it a swirling motion and makes it spiral all the way down the tube. A fan is provided to blow air through the annular spaces between the tubes, which cools the water; the same water being used over and over again for condensing purposes, including the small addition, in the case of surface condensing, or water of condensation, in the case of a jet condenser, the heat given to it in the condenser being taken from it in the water cooler. In plants situated on expensive sites the cooler can be located on the roof, or in any other position where space is not available for other purposes. The cooler proper is so simple and requires so little attention that inaccessible positions are entirely unobjectionable. In other cases, however, it is better to place the cooler on a level with the ground floor, as the height through which the water must be lifted is thereby reduced.

The air fan may be driven by any suitable source of power, an electric motor being preferable, owing to its high efficiency and automatic working. For large installations of over 500 horse-power the cooler is furnished with an independent power-driven auxiliary equipment for operating the air fans and circulating air and feed pumps. The ordinary reciprocating steam pump may be much improved in the matter of efficiency by the substitution of an auxiliary steam engine to operate the entire auxiliary equipment. By this means may be obtained an economy of steam consumption of 20 pounds per horse-power, which, it is well known, is unattainable by means of any direct-acting pumping engine; it is rarely less than twice this amount in any case. The equipments put out by M. T. Davidson are carefully designed for high economy in all auxiliaries, thereby greatly lowering the fuel consumption per active horse-power from that of non-condensing engines.

Mr. Davidson maintains branch offices at 133 Liberty Street, New York City, and 30 Oliver Street, Boston, Mass.

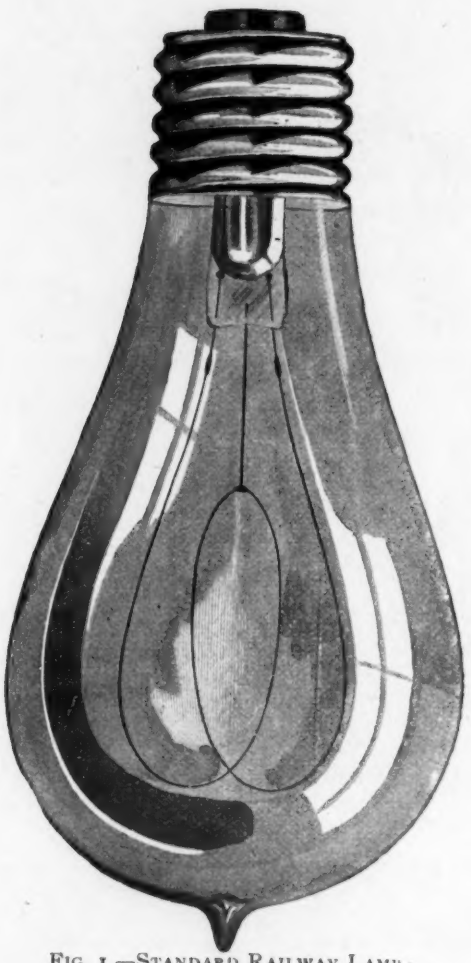
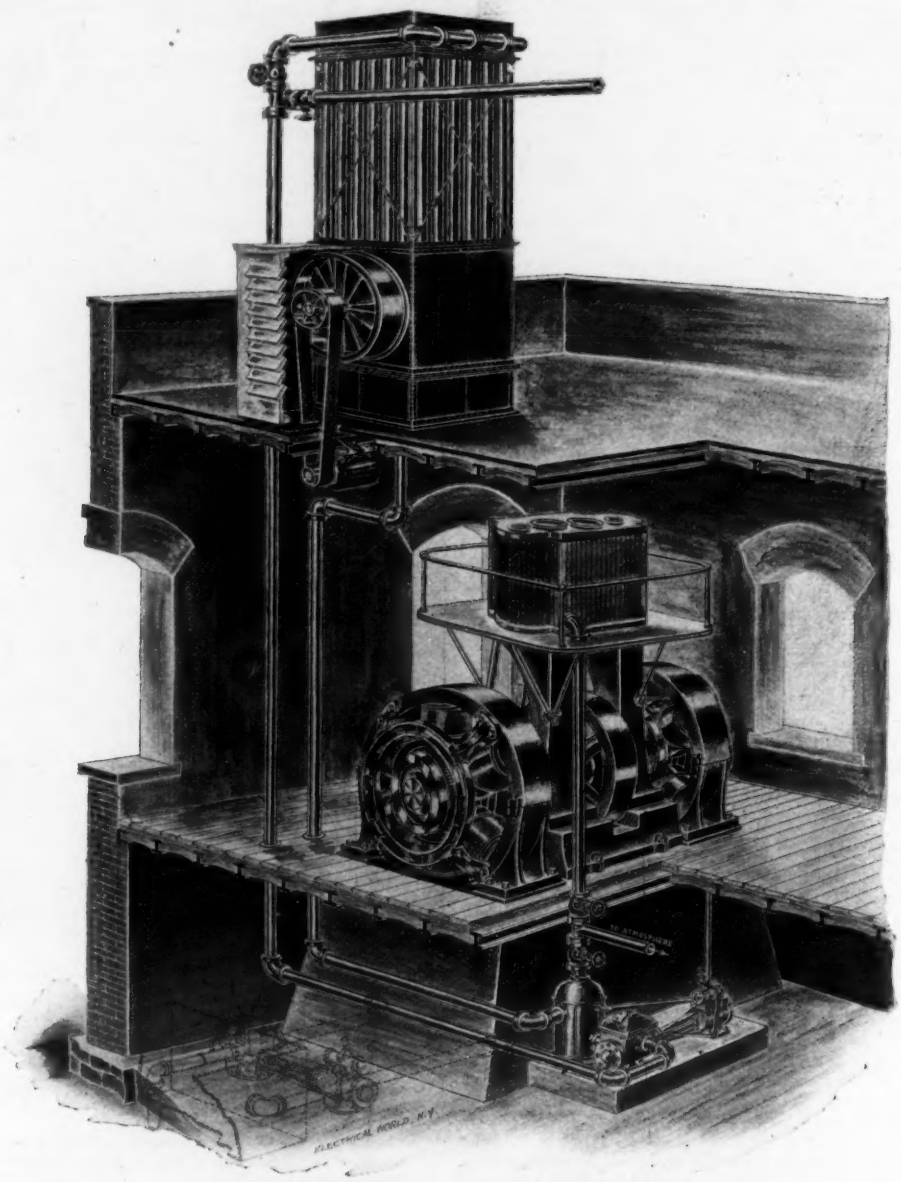


Fig. 1.—Standard Railway Lamp, Exact Size



An Application of the Evaporation Water Cooler.

NEWS OF THE WEEK

Financial Intelligence.

DIVIDEND.—The Directors of the West End Street Railway Company, Boston, on December 1 declared a semi-annual dividend on the preferred stock of 4 per cent., payable January 1, 1898.

THE GROSS EARNINGS of the Brooklyn Rapid Transit Company, Brooklyn, N. Y., for the month of November were $433,703, an increase of $12,243, as compared with those of the corresponding month last year.

THE BROOKLYN RAPID TRANSIT COMPANY on November 30 secured control of the Sea Beach and Sea View railroads. All of the stock, of a par value of $650,000, and part of the $650,000 of bonds of the Sea Beach Company, and all of the stock and bonds of the Sea View Company, were purchased outright by the Rapid Transit Company for about $750,000.

THE DIRECTORS OF THE WEST END STREET RAILWAY COMPANY, Boston, held a meeting on December 1, and voted to petition the railroad commissioners for authority to lease the road for twenty-five years to the Boston Elevated on the basis of 8 per cent. on the preferred stock and 7 per cent. on the common. The petition was filed, and December 10 set for the hearing.

Special Correspondence.

NEW YORK NOTES.

Office of THE ELECTRICAL WORLD,
253 Broadway, NEW YORK, Dec. 4, 1897.

MR. J. H. MASON, general manager of the Simplex Electrical Company, Boston, Mass., was in New York last week on business.

THE SPRAGUE ELECTRIC COMPANY has moved its offices from the Postal Telegraph Building to the Commercial Cable Company's new building at 20 Broad Street.

UNDERGROUND CONDUIT ROAD OPENED.—The Fourth Avenue line of the Metropolitan Street Railway Company is now in successful operation between the Harlem River and Astor Place. This line has just been entirely rebuilt and equipped on the underground conduit system. The section of the line below Astor Place down to the Post Office is not quite ready for operation.

THE BROOKLYN RAPID TRANSIT COMPANY, which on November 30 purchased the Sea Beach and Sea View railroads, will equip both lines at once with the electric system. It is announced that trolley cars will be running to Coney Island over the Sea Beach road in three weeks. The financial consideration involved in this deal is referred to briefly in the financial columns of this issue.

ELECTRIC LIGHT IN NEW YORK.—In a recent issue of the New York *Herald* some interesting facts and statistics are given concerning electric lighting in New York City. They show the total number of electric lights, both arc and incandescent, to be 1,030,468. To light this vast number of lamps entails an expenditure of $13,698 per night, thus making the total annual cost $5,000,000. The estimated total candle-power is 50,000,000.

THE NEW YORK POWER & LIGHT COMPANY applied to the Brooklyn Board of Aldermen on November 29 for a franchise to supply that city with gas and electricity. A similar application was made by the Brooklyn Gas & Electric Company. Both applications were referred to appropriate committees. The board, at the same meeting, granted permission to the Municipal Electric Light Company to extend its wires all over the city. This company has hitherto been operating only in the eastern section of the city.

POSSIBLE UNIFICATION OF BROOKLYN RAILWAYS.—It is stated that negotiations have been commenced in Brooklyn looking toward some sort of a traffic arrangement between the different street railway companies in that city, so that they can all be operated under one management. Such an arrangement, it is stated, would effect a saving of $1,000,000 a year. Just how such a combination may be brought about it is yet too early to state, but President Rossiter, of the Brooklyn City Company, is reported to be in favor of the idea, whether it takes the form of a combination, an actual consolidation, traffic arrangement, lease, or an ordinary plain, everyday agreement.

THE BRIDGE TROLLEY INJUNCTION.—The Brooklyn Rapid Transit Company evidently believes that the injunction case now pending before the Appellate Division of the Supreme Court cannot result otherwise than in its favor. The injunction has stopped the work at the New York terminal, where it is proposed to cross from the north side of the bridge to the south side on curves at grade. The injunction applies to the New York end of the work only. The work on the rest of the bridge is being advanced and is about completed. Officials of the company state that they still expect to run cars over the bridge by January 1. It is thought that the injunction case will be decided by December 15, and if it is favorable to the company the work at the New York terminal will be prosecuted with vigor.

THE COMMERCIAL CABLE & TELEGRAPH COMPANY has been incorporated at Albany, N. Y., with a capital stock of $100,000. The general route of the company is stated to be from New York City to Mojave, Cal., touching at all important cities on the route and having branches from the main line throughout all the States traversed; also through the New England and Southern States, and from New York to England and France. The certificate says that the company may connect with every city, town and village within the United States. The directors are: John W. Mackay, of Virginia City, Nev.; Albert B. Chandler, William H. Baker, and Edward C. Platt, of Brooklyn; Clarence H. Mackay, George G. Ward, George Clapperton, and Charles E. Merritt, of New York City; James W. Ellsworth, of Chicago; Edward C. Bradley, of East Orange, N. J.; William C. Van Horn and Charles R. Hosmer, of Montreal, and Dumont Clarke, of Schraalenburg. N. J. The organization of the company, we are informed, is simply a legal requirement to complete the arrangements made a year ago by which the relations of the Postal Telegraph-Cable Company and the Commercial Cable Company were brought into closer union. The plan for accomplishing this result was outlined in THE ELECTRICAL WORLD of December 1, 1896. The organization of the new company does not in any way affect the status of either of these two companies or their relations, nor does it involve any change in the name of either; it is a necessary legal requirement in carrying out the original plans.

TROLLEY FRANCHISE IN BROOKLYN.—A surprise was furnished by the favorable report of the railroad committee of the Brooklyn Board of Aldermen on November 29, on the application of the East River & Atlantic Ocean Railroad Company for franchises for about 25 miles of new trolley routes. The committee has had the matter in hand for over six months, and it had been generally supposed that no action would be taken, in view of the approaching consolidation of the cities. The suddenness of the committee's action took everyone by surprise. A motion was made to lay the matter over for one week, but it was defeated, and the report was adopted by the board by a vote of 17 to 5. Had not the hasty legislation met with a legal obstacle in the form of an injunction the franchises would probably have been granted, even should Mayor Wurster veto the resolution, because, as the vote indicates, more than two-thirds of the aldermen voted in the affirmative on its passage. The injunction was procured by a New York newspaper, temporarily restraining Mayor Wurster from approving the resolution, and also enjoining the Brooklyn Board of Aldermen from passing the resolution over the mayor's veto in case he should exercise his veto power. The injunction was granted by Justice Gaynor, of the Supreme Court. The East River and Atlantic Ocean Railroad Company was organized by P. H. Flynn. It is stated that the various routes for which franchises are sought would form valuable connections for the Nassau Company. In the resolution passed by the Board of Aldermen the company gets practically all it asked for. The grants are made on condition that the company pay 3 per cent. of its gross earnings to the city, and sell six trip tickets for 25 cents.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS held its eighteenth annual meeting in the society's house, at 12 West Thirty-first street, on November 30, December 1, 2 and 3. There was a very large attendance of members, and the papers read at the meetings were of extraordinary interest and of high character. At the first session President W. R. Warner delivered an address entitled "The Evolution of the Telescope." On Wednesday morning the business session of the annual meeting was held. Among the reports submitted was that of Mr. C. J. H. Woodbury, who represented the society at the conference on Standard Electrical Rules. Of the two papers read at this session one was by Mr. F. W. Dean, on "Reduction of Cost of Steam Power from 1870 to 1897." An abstract of this paper is published in another column in this issue. On Wednesday evening a reception and conversazione was held at Sherry's. Many ladies were present, and dancing was indulged in. A supper was also served. There was a large attendance, and a very delightful evening was spent. The Thursday morning session was devoted to the reading and discussion of papers. Among the papers read were two of special interest to electrical engineers, viz.: "Multiple Cylinder Engines. Effects of Variation of Proportions and Variable Loads," by Prof. R. H. Thurston, and "Notes on Rating Electric Power Plants on the Heat-Unit Standard," by W. S. Aldrich. Abstracts of both of these papers are given elsewhere in this issue. At the fourth session, which was held on Thursday evening, Mr. W. B. Smith-Whaley read a paper, among others, entitled "Electricity in Cotton Mills." The closing session was held on Friday morning. The afternoons during the convention were devoted to social enjoyment, visiting points and places of engineering interest, etc. Among the electrical plants visited were the power house of the United Electric Light & Power Company, on Twenty-eighth street, and the eastern power house of the Brooklyn City Railroad Company. The next spring meeting of the society will probably be held at Niagara Falls.

NEW ENGLAND NOTES.

Branch Office of THE ELECTRICAL WORLD,
Room 91, Hathaway Build'ng, 620 Atlantic Ave.,
BOSTON, Mass., Dec. 3, 1897.

THE TELEPHONE OUTPUT of the Bell Telephone Company for the month ending November 20, as shown in a statement issued on November 30, shows the gross output to be 29,023. The output during the same month last year was 15,185, and in 1895 it was 18,439. The net output during these periods, respectively, was 21,206, 6,112 and 12,297. The total number of instruments outstanding on November 20 this year, last year and in 1895 was 904,678, 770,010 and 670,180, respectively.

SALE OF THE ARMINGTON & SIMS ENGINE BUSINESS.—The real estate and property of the Armington & Sims Engine Company, Providence, R. I., will be sold at public auction at noon, December 29, 1897. The land contains about 92,000 square feet, on which there are twelve brick and stone building, mostly connected, and sufficient for all requirements if the business is continued. The property also includes the tools and machinery; all stock on hand, finished and in process, consisting of seventeen engines,

practically completed, ranging from 10 to 250 horse-power; patterns; all letters patent owned by the company; office furniture and fixtures; horses, wagons, etc. The real estate and fixed machinery will be sold subject to a mortgage.

Washington Notes.

WASHINGTON, D C., Dec. 1, 1897.

BERMUDA-JAMAICA CABLE.—Vice-Consul Manley Jones writes to the Department from Turk's Island, W. I., that a contract has been entered into to lay a cable from Bermuda to Turk's Island, and thence to Jamaica. The Direct West India Cable Comapny, Limited, has secured the contract. The steamship "Scotia," with the cable on board, will leave London about the middle of December, for Bermuda, whence she will begin to lay the cable. It is thought that the cable will be in operation by the end of January, 1898.

DEMAND FOR INCREASED TROLLEY MAIL SERVICE.—Postmaster General Gary, in his current annual report, states that the greater expedition to the mails, secured through transportation on electric cars, has created an increasing demand for the extension of the service. There are more applications now pending in the Post Office Department for the establishment of electric car mail service than can be met from the appropriation for the current year. The annual rate of expenditure for the electric and cable car postal service on June 30, 1897, was $183,038.43. Uniform rates of pay have been adopted, based on space and mileage.

THE EXTENSION OF THE LONG-DISTANCE TELEPHONE SERVICE has increased lately in the Government departments, and it is regarded with great favor. It is a great relief to officials who wish to be away for short periods, or who are called away on business, for they can feel certain of being in constant and instantaneous communication with their respective bureaus. Secretary Bliss not infrequently holds conversations while he is in New York with officials of his department, and while here he has interviews with his business managers in New York. Postmaster-General Gary, when in Baltimore, uses the same means in looking after the affairs of his department, and while here in supervising his private business. Nearly all the Cabinet officers do the same thing, and it is confidently asserted that more than one member of the Cabinet would not be in such a position were it not for the convenience of modern means of communication, which no longer makes it necessary for an official to be tied to his desk in the department over which he presides.

Buffalo and Niagara Falls Notes.

BUFFALO, N. Y., Dec. 3, 1897.

THE NEW WHEEL PIT of the Niagara Falls Power Company is finished, and the extension to the power house is also practically completed. The next step in the development of the work will be to put in the new turbines and dynamos, and remove the bulkheads between the old wheel pit and the new one.

THE APPOINTMENT of Mr. W. Caryl Ely as general director of the Pan-American Exposition is announced. Mr. Ely is president of the Buffalo & Niagara Falls trolley line, and in his new position will no doubt bring electrical matters at the exposition to the front, should there be any disposition to neglect them on the part of the general management.

THE AMERICAN CAPITALISTS who obtained the Canadian grant of privileges to develop power on the Canadian side of Niagara Falls are at work on the problem, and have opened negotiations with the Niagara Falls Park & Island Railway Company. It is proposed to use this company's plant as a starting point. Secretary Rankine, of the Power Company, reports that machinery is being bought.

THE BUFFALO STREET RAILWAY COMPANY, it is stated, proposes to install in one of its stations a storage battery plant, to be used in connection with the operation of its system. The company has already ordered the batteries from the Electric Storage Battery Company, of Philadelphia. There will be 290 cells, which will be set up in a fireproof building, 40 feet by 70 feet, to be erected adjoining the Niagara Street station. It is stated that the battery plant will be ready for use in about ninety days. The output of the battery will be about 1200-ampere hours, and it is stated that the current will be utilized to even up the demand on the Niagara Falls line, and bridge over any emergencies. The move in this direction appears to have been suggested by a similar plant now under construction by the Consolidated Traction Company, of Pittsburg, Pa. The batteries for the Buffalo Railway Company, it is stated, will be charged partly by the Niagara current and partly by the company's steam plant.

Pittsburg Notes.

PITTSBURG, Pa., Dec. 3, 1897

CARNEGIE TO MAKE GIRDER RAILS.—It is stated that the Carnegie Company has completed arrangements to compete for the steel girder-rail trade. All necessary alterations in the plant at Homestead are about completed. The company proposes to roll 9-inch 100-pound rails, for which there is a heavy demand at the present time. These rails, it is stated, will be made of open-hearth steel, which is an innovation in the trade. Iron men predict that in a year Homestead will be the steel girder rail centre of the world.

CONDUIT FACTORY FOR BEAVER FALLS.—The Boston Electric Conduit Company, which recently located at Versailles, Pa., has made arrangements with the McCool Tube Company, of Beaver Falls, to remove its factory to the latter place. The Conduit Company manufactures insulated tubing for electric wires, and the pipe used by it is manufactured by the McCool Company. By moving its factory to the premises of the McCool Company the Conduit Company will effect a considerable saving in charges for freight and handling, besides avoiding delays in transportation.

WIRES TO GO UNDERGROUND IN ALLEGHENY.—About a year ago an ordinance was passed by Allegheny councils prescribing as the district from which overhead wires should be removed the territory bounded by Cedar Avenue on the east, North Avenue on the north, Allegheny Avenue on the west, and the Ohio River on the south. This territory takes in nearly all the main business portion of the city. The underground conduits on Western Avenue and Ohio Street have now been completed. The removal of wires and poles from these streets has been commenced, and will be pushed to completion immediately. Work on the other streets will not be carried forward until next summer.

UNITED TRACTION COMPANY'S ORDINANCE VETOED.—As announced in The Electrical World last week, a mass meeting of Allegheny citizens was held in Carnegie Hall last Friday evening, to discuss the United Traction ordinance recently passed by councils. This ordinance has been described in a previous issue of The Electrical World. Resolutions were adopted denouncing the ordinance, and a committee was appointed to wait upon the mayor and urge him to veto it. This committee had a conference with the mayor on Saturday morning, and soon afterwards the mayor announced that he had vetoed the ordinance. Select Council will doubtless pass it over the mayor's veto, but in Common Council enough votes have been pledged, opposing the measure, to sustain the veto. This will leave the United Traction Company where it was before the blanket ordinance was proposed, and unless some measure can be passed that will be satisfactory to the company, it will have to continue to operate under the old franchises owned by its underlying companies.

MORE COMPETITION FOR THE BELL TELEPHONE COMPANY.—The Maryland, Pennsylvania & West Virginia Telephone Company has recently been chartered under the laws of West Virginia, with a capital stock of $1,000,000. Among the incorporators are Milton I. Baird, of Pittsburg; J. J. Hoblitzell, of Meyersdale; J. M. Reynolds, of Bedford, and E. E. Hitchens, of Frostburg, Md. The company proposes to build a trunk line between Baltimore and Pittsburg, connecting with exchanges now in operation, or to be established, in all the important towns along the route. It is the intention to tap at Somerset the lines of the Somerset County Telephone Company, thus gaining connections with Johnstown, Greensburg, and other points where independent companies are in operation. At Frederick connections will be made with the Interstate Telephone & Telegraph Company, whose system extends to Eastern Virginia, North Carolina, and the eastern part of West Virginia. At Piedmont, W. Va., junction will be made with the Gordon Telephone Company, giving access to the southern portions of West Virginia and Tennessee.

Chicago Notes.

Branch Office of The Electrical World,
936 Monadnock Building,
CHICAGO, Ill., Dec. 4, 1897.

TO RESUME DIVIDENDS.—It is reported that the Central Union Telephone Company may resume dividend payments next January at the rate of 4 per cent. Dividends have been suspended since January, 1895, but in the last two years small telephone exchanges throughout the country covered by its system have failed, and the property is showing greatly increased earnings. The physical condition is excellent, extensive improvements having been made.

IT IS STATED that the Gas Trust is going into the electric light business, the franchise of the Commonwealth Electric Company having been sold to the Gas Company. It is said, also, that the work of installing an electric light plant will commence at once. Another rumor has it that the franchise will be placed upon the market for sale. This franchise is one of the most liberal ever passed by the Council, as it includes heating, lighting and telegraph service. The price of the franchise is placed at $250,000.

MR. CHARLES T. YERKES, it is reported, has practically closed a deal which has been under consideration for some time, by which $3,500,000 will be obtained upon the bonds of the Northwestern Elevated Railroad Company. The details of the loan have not been made public, but it is announced on good authority that all the money needed for the completion of the road will be obtained, and that the work of finishing the structure, building the power house and furnishing the equipment will be under way as soon as the weather will permit. The iron work for the new road will ready before spring, and it is believed that six months will be sufficient time to erect a power house, put up the iron work and get the road in operation. It is expected that the line will be ready to open by October 1 next.

Milwaukee Notes.

MILWAUKEE, Wis., Dec. 3, 1897.

EAU CLAIRE, WIS.—The Chicago & Northwestern Telegraph & Telephone Company has been incorporated, with a capital of $25,000, which will be increased to $500,000, as needed. A line will be built from here to Chicago.

SUSPENDED OPERATIONS FOR THE WINTER.—The Janesville Street Railway Company, Janesville, Wis., has stopped running cars on the line for the rest of the winter. This is due to poor business. Five hundred dollars is reported to have been lost in the last two months.

TO PAINT THE POLES.—As the result of the city of Racine, Wis., having to pay $2000 damages for the death of a boy who was struck by a falling pole, the Board of Public Works has ordered all poles in the city to be painted. The lighting, telephone and other companies' poles must be painted a distinguishing color, the color being decided by the board.

THE MADISON CITY RAILWAY, Madison, Wis., has been sold under foreclosure for $110,000. There were three bidders, local capitalists, making offers for the plant. The road was bid in by Trustee Newcomb for the bondholders. The bonds and interest due aggregate $174,412. The road has been in receivers' hands a year and a half, but is now paying property.

A VERY COMPLETE PRIVATE TELEPHONE EXCHANGE will soon be finished by the Milwaukee Electric Railway & Light Company. Chief Elec-

trician Rau has the work under supervision. The exchange, with a capacity of 100 calls, will be located in the Broadway offices, and will connect with twenty-five stations. The exchange will connect with the Wisconsin Telephone Company by four trunk lines. Whitefish Bay, North Greenfield, Wauwatosa and South Milwaukee will be four of the stations. The plant will cost about $10,000, and will cover about 100 miles.

ST. LOUIS NOTES.

ST. LOUIS, Mo., Dec. 2, 1897.

RAILROADS OBJECT TO TROLLEY EXTENSIONS.—The steam lines are fighting hard the extension of trolley lines, as they fear a reduction of their earnings if electric companies branch out. Promoters of county lines have already felt the effect of the opposition.

VESTIBULE CARS.—A resolution was passed in the House of Delegates this week calling upon the prosecuting attorney to make a certain street railway companies show cause why the Vestibule act, passed by the last Legislature, should not be enforced in their case.

TELEPHONE WAR.—Although the report is denied by the representatives of both the Kinloch Telephone Company and the Bell Telephone people there does not seem to be a doubt that there will be a war, and that it will be conttinued for some time. The Kinloch Company having increased its stock, will have an even $3,000,000 with which to make a fight for an established business in St. Louis. On the other hand the Bell telephone people have also increased their stock, and will have a nice surplus to fight for business with.

PACIFIC COAST NOTES.

SAN FRANCISCO, Cal., Nov. 25, 1897.

THE UNION TELEPHONE COMPANY'S EXTENSION, from Union, Ore., to Baker City, is now open for business.

THE CHILCOOT RAILROAD & TRANSPORTATION COMPANY'S telephone line has been completed from Dyea, Alaska, to Sheep Camp, a distance of 15 miles. The company has built a railroad from Dyea to the head of the Chilcoot canyon.

SECRETARY ALGER'S DECISION to proceed to advertise for bids for the construction of the breakwater at San Pedro, Cal., will probably insure the speedy building of both the San Pedro and the Pasadena electric lines, which have long been under consideration.

THE PEOPLE'S MUTUAL TELEPHONE COMPANY, of San Francisco, has been granted an additional year's time in which to expend the sum of $100,000 in installing and perfecting an independent telephone system. Conduits are to be laid in the principal streets.

PROPOSED TELEPHONE LINE TO DAWSON.—Mr. A. F. Sands, of Tacoma, Wash., manager of the Puget Sound lines of the Sunset Telephone Company, has gone to Alaska, and it is reported that he will make estimates as to the expense of constructing a telephone line from Dyea to Dawson-on-the-Yukon.

MUNICIPAL LIGHTING IN ALAMEDA.—According to a recent report of City Clerk Lamborn, the municipal electric lighting plant in Alameda, Cal., has been operated for four years at a net cost, for public lighting, of $36,071.38. It is claimed that had the city been lighted by contract at the rates prevailing in Oakland, the cost would have been $43,052.40 for arc lights alone. Street lamps, railroad stations and public buildings were lighted.

SOME IMPORTANT CHANGES have been made in the directorate of the Market Street Railway Company, San Francisco. Mr. I. W. Hellman, president of the Nevada Bank, has purchased a large block of the railway company's bonds and has succeeded Mr. W. J. Adams as a director. It has been announced that the company will build an electric car line on Eighth Street, extending from Market to Brannan, in the near future. It is said that a syndicate, headed by Mr. Hellman, invested in the company's bonds to the amount of $4,750,000.

TELEGRAPH EXTENSION.—It is reported on good authority that the Western Union Telegraph Company has practically decided to extend its lines in the Puget Sound region in Washington State, and to build to Victoria, B. C. The new line will extend from Seattle to Port Angeles, Wash., covering Port Madison, Port Blakely, Port Townsend and other intermediate points. From Port Angeles a high-grade cable will be laid across the Straits of San Juan de Fuca, unless Superintendent Frank Jaynes, who is now making a tour of inspection, should hit upon a better route for the cable to Vancouver Island. Additional lines will be built, according to the probable necessities of the northwestern corner of the United States.

CANADIAN NOTES.

OTTAWA, Dec. 3, 1897.

THE LACHINE RAPIDS HYDRAULIC & LAND COMPANY, of Montreal, contemplates supplying the shipping interests of that port with electric power for the purpose of loading and unloading vessels, at a price much lower than the same work can be done by steam, besides ridding the harbor front of smoke and noise.

TO ABSORB SMALL ELECTRIC LIGHT COMPANIES.—It is understood that a syndicate of Toronto capitalists has been formed to secure interests in a number of the smaller electric light companies throughout Ontario. The idea is to secure the bulk of the stock in these companies, and then amalgamate them all under one management. An agent of the syndicate is at present traveling through the province inspecting and valuating the various electric light properties which the syndicate desires to secure.

THE CHEAP ELECTRIC POWER QUESTION in Toronto, Ont., will not down. The interest shown in it is extending all over the province, and the cities and towns between Toronto and Niagara Falls seem prepared to join in a comprehensive project which will give them power from the wires expected to be laid from the Falls to that city. There are two routes by which Niagara power may be brought to Toronto—the first, and most direct, by cable across the lake; the second, by overhead wire around the end of the lake, and passing, en route, Hamilton, Oakville and other places, where power could be largely used. The probable use of electrical energy within the city of Toronto is, for street lighting, 800 electrical horse-power; for lighting buildings and private residences, not served by the Edison system, 2000 horse-power; for electric street railways, 3000 horse-power; for incandescent lighting, 2000 horse-power, and for water works operations, 3000 horse-power.

THE CATARACT POWER COMPANY, of Hamilton, Ont., having had sufficient stock subscribed to complete its plant, has lost no time in getting down to work. A contract has been let for the construction of the canal, which will be about 4½ miles long, from near Allanburgh to the brow of the "mountain," not far from De Cew's Falls, where a head of 270 feet will be obtained. The water will be taken from the Welland Canal, a short distance above Allanburgh. The distance from the power house to the terminus at Hamilton will be 38 miles. This will be the longest electrical transmission line as yet in actual operation, except that of the Blue Lakes Water Power Company, in California, which transmits power 45 miles. The Cataract Power Company will have 4000 horse-power available, and has already contracted with a number of corporations and private manufacturing concerns fo supply of power in Hamilton. The plant will be in operation in May next.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Nov. 24, 1897.

THE "HEADLAND" MOTOR CAR.—Still another electric motor car has commenced running about the London streets, and I recently had a very enjoyable and satisfactory ride on it. The equipment of the car consists of a "Headland" accumulator of forty cells and a single motor, geared by a single reduction bevel gear to the rear axle. The regulating arrangements provide for throwing the cells either in four parallel rows of ten each, two parallel rows of twenty each, or the forty cells in series, and no resistances are used either in starting or in regulating the speed. This arrangement is found to work out most economically, and would seem to be much more satisfactory than the double wound armatures, and two commutator motors, used on some of the electric cabs about town. The normal current from the "Headland" battery is about forty amperes, but on starting as much as eighty or 100 amperes may pass through the motor. It is said that the car will run for 50 miles on a single charge, a statement which I hope to test before long. The details of the motor and gearing for this car have been worked out by Mr. Parr, of the Headland's Storage Battery Company.

THE TORQUAY ELECTRIC SUPPLY PLANT.—On Friday last I went down to Rugby to witness some trials of a new steam-driven alternator at Messrs. Williams & Robinson's works. The machine consists of a 125-kw "Flynn" alternator, direct coupled to a 25-hp Willans engine. There are some features of interest in the alternator which I may mention. The armature and field magnet coils are fixed, but the whole of the field magnet core revolves, and the poles are arranged in two circles, the north poles being staggered with respect to the south pole, *i. e.*, each north pole is opposite the space between the two south poles. By this arrangement the field through the coils undergoes a complete reversal in each cycle, while the field through any part of the iron of the machine never varies more than from zero to a maximum in one direction. This generating set forms the first of three steam alternators for the new Torquay electric supply station. The rest of the equipment of the station comprises a battery of Babcock & Wilcox water tube boilers, with feed pumps of the Worthington duplex type. The condensers are of the ejector type, by Messrs. Ledward & Co. The station will principally supply current for arc and glow lighting, but in anticipation of a certain demand for electric motor power, the frequency of the alternators has been fixed at 50 ~. For the street arc lamps Ferranti rectifiers will be used.

General News.

NEW INCORPORATIONS.

THE WOODFIELD TELEPHONE COMPANY, Woodsfield, Ohio, has been formed with a capital stock of $10,000.

THE ENTERPRISE TELEPHONE COMPANY, of Excelsior Springs, Mo., has been organized, with a capital of $30,000, by J. C. and C. H. Opinger, R. H. Hood and others.

THE NORTHWEST MISSOURI TELEPHONE COMPANY, of Tarkio, Mo., has been incorporated, with a capital stock of $6,000. The incorporators are J. H. Davis, F. S. Travis, W. F. Marshall and others.

THE L. I. FLETCHER COMPANY has been organized at Portland, Me., for the purpose of dealing in electrical machinery and goods. The officers are: President, Lewis I. Fletcher, of Lowell, Mass.; treasurer, George E. Grant, of Boston, Mass. The capital stock of the new company is $25,000.

SOUTHERN CALIFORNIA ELECTRIC SUPPLY COMPANY, Los Angeles, Cal., has been formed, with a capital stock of $50,000. The directors are Russell H. Ballard, Daniel B. Kearney, George P. Curtis, William L. Percey, Los Angeles, and Albert C. Jewett, San Francisco, Cal.

THE CALHOUN COUNTY TELEPHONE COMPANY, Albion, Mich., has been incorporated, with a capital stock of $100,000. The officers are: W. S. Kessler, president; F. E. Palmer, vice-president; A. J. Little, treasurer; F. L. Irwin, secretary. The principal place of business will be at Battle Creek.

THE PORT JERVIS TELEPHONE COMPANY, Port Jervis, N. Y., has been incorporated for the purpose of operating a telephone line between Port Jervis and Deer Park. The directors are John P. Van Etten, of Conashaugh, Pa.; William L. Cuddeback, Moses Depuy, Samuel H. Gariss, J. Wallace Gordon, Fred Mason, William A. Parshall, Charles P. Reuling, William E. Scott, John T. Vanetten and Philip G. Wagner, of Port Jervis. Capital stock, $40,000.

The Electric Railway.

BELAIR, MD.—A new electric railroad will be constructed between this place and Havre de Grace.

ASHLAND, PA.—The Ashland Central Electric Railway Company has been granted the right of way.

TROY, N. Y.—The Mechanicville & Stillwater Railroad Company has petitoned the Village Trustees for a franchise.

HINGHAM, MASS.—The officials of the Hanover Street Railway Company have decided not to extend its line from Assinippi to Norwell Centre this fall, but will do so in the spring.

SHELBYVILLE, MO.—An electric railway between Shelbina and Shelbyville, agitated from time to time, is again revived. Orville G. Wales, of St. Louis, is asking right of way.

SYRACUSE, N. Y.—The proposed electric railroad from the city to the resorts on Onondaga Lake is to be constructed, according to the statements of officials of the Onondaga Lake Railroad Company.

RICHMOND, S. I., N. Y.—The Midland Electric Railway Company intends to extend its line from Richmond through Roseville to Tottenville, and thence back to the eastern side of the island to connect with its Midland Beach line at Grant City.

Legal Note.

TELEPHONES IN TELEGRAPH OFFICES.—The right of a telephone company to require a telegraph company to place a telephone instrument in its office for use in receiving and transmitting messages on the ground that it has allowed another telephone company to have an instrument there for that purpose is denied, in the case of the people *ex-rel* Cairo Telephone Company *vs.* Western Union Telegraph Company (Illinois), on the ground that the telegraph company cannot be compelled to receive oral messages, and that by waiving its rights in that respect in favor of one company it is not compelled to do so in favor of another.

Personal Notes.

MR. CHARLES S. KAUFMANN, secretary of the American Battery Company, Chicago, was in New York early in the week.

MR. W. J. MAC CONNELL, representative of the *Electrical Engineer* in Chicago, was married November 25 to Miss Hortense O'Connor.

Obituary Note.

MR. GEORGE R. BLODGETT, attorney for the General Electric Company, was shot in a mysterious manner early on the morning of December 3, at his home in Schenectady, N. Y. A reward of $5,000 has been offered by the General Electric Company for the capture of the assailant, but up to the present writing he has eluded the vigilance of the law officers. The shooting is enshrouded in the deepest mystery, and everyone is at a loss to ascribe a reasonable cause for the unfortunate affair. Mr. Blodgett's condition was, at last reports, said to be precarious. Mr. Blodgett has for several years been in charge of the patent department of the General Electric Company, and possessed a very wide technical knowledge on patent matters. He was regarded as a most valuable man by the officers of the company.

LATER.—Mr. Blodgett died on Saturday afternoon, after an operation made by the physicians in an effort to extract the bullet.

Trade and Industrial Notes.

THE WALKER COMPANY has closed a contract for twenty 125-hp motors for the Metropolitan "L" road, Chicago, Ill.

THE MISSOURI TELEPHONE MANUFACTURING COMPANY, St. Louis, Mo., is issuing an attractive calendar for 1898.

NINETEEN ELECTRIC ELEVATORS will be installed in the Boston Terminal Station, Boston, Mass., by the Sprague Electric Company, New York.

MR. PHILIP J. HERTZ, agent of the Stromberg-Carlson Telephone Manufacturing Company, Chicago, is now permanently located at 166 Liberty Street, New York, looking after the interests of the company in the east.

THE CENTRAL ELECTRIC COMPANY, Chicago, announces that it is carrying full lines of the Bryant, Perkins, Hart, Paiste and Anchor specialties, and is prepared to make shipments of any quantities of these well-known goods from stock.

MR. J. C. MOULTON, formerly of the Sawyer-Man Electric Company, and also of the A. B. C. Company, has re-entered the electrical field, and is now with the Columbia Electrical Supply Company at 329 Fourth Avenue, New York City.

THE G. & H. BARNETT COMPANY, Philadelphia, Pa., has received the award of the Nashville Exposition of a silver medal for the excellence of its goods exhibited. It is stated that this company received the only and highest award in its class of exhibits, which was in the line of files.

THE DYNAMO BRUSHES manufactured by Mr. Charles S. Barkelew, Middletown, Ohio, are in use in several of the largest plants in the United States. Mr. Barkelew states that there is a steadily increasing demand for his brushes, several large orders having been booked during the month.

MESSRS. J. H. BUNNELL & CO., 76 Cortlandt Street, New York, have an attractive display of electrical apparatus in their front window. On a large operating turn table are shown a miniature electric railway, lamps, switches, medical apparatus, etc. This method of displaying goods is a very effective one.

THE GENERAL ELECTRIC COMPANY BUYS MORE LAND.—The General Electric Company has acquired some property adjacent to its present plant in Schenectady. The area of the newly acquired property is said to be larger than that already possessed by the company and covered by its works.

THE PATTON MOTOR CAR.—In The Electrical World of November 28 was published a description of the Patton motor car recently tested in Chicago. Through inadvertence we failed to mention the fact that the one hundred 200-ampere-hour storage cells used in the operation of the system were made by the American Battery Company, Chicago, which claims to be the oldest manufacturer of storage batteries in the United States.

THE BERLIN IRON BRIDGE COMPANY, East Berlin, Conn., is supplying and erecting the steel frame work for the new main foundry building of the Foxboro Foundry & Machine Company, Foxboro, Mass. The Foxboro Company's plant was recently destroyed by fire, and in its rebuilding the plant will be of a substantial and fire-proof character. The main building will be a steel-frame structure.

THE PACKARD TRANSFORMER is still holding its reputation for indestructibility. As now made, this transformer is so thoroughly insulated that it seems almost impossible to burn it out. In only very rare cases has it been unable to withstand very severe lightning discharges. This immunity from burnouts has made it very popular, and the Electric Appliance Company, Chicago, is reaping the benefits of its popularity this fall in a very largely increased trade.

THE LUCENT OIL WORKS, 212 South Third Street, Philadelphia, Pa., announces that it has bought from Bosshardt, Wilson Co. the business, refinery, plant, formulas, etc., of the Lucent Oil Works, and with ample capital to increase the volume of the business promises to continue to supply electrical companies and others with oils of a uniformly high grade. Mr. C. A. Bragg is president of the Lucent Oil Works, and Mr. C. A. Wilson general manager.

THE "HUGHES" ELECTRIC SYSTEM OF POLICE AND FIRE SIGNALS is illustrated and described in a catalogue just issued by Mr. E. C. Hughes, 511 Sansome Street, San Francisco, Cal. The police patrol feature of this system renders it possible for the central station to summon any or all officers on patrol to their boxes for instructions. Another important feature is the auxiliary or private box system, by which a citizen is, upon payment of a small rental, provided with police calling apparatus.

SOLID SHEET MICA SEGMENTS, as produced by Mr. A. O. Schoonmaker, 158 William Street, New York City, are evidently giving excellent satisfaction to those using them, judging from several testimonial letters published in circular form by Mr. Schoonmaker. These letters were written by the Utica Electrical Manufacturing & Supply Company, Utica, N. Y.; the Atlanta (Ga.) Consolidated Street Railway Company, the Trenton (N. J.) Passenger Railway Company, and Messrs. Johnson & Morton, electrical engineers and contractors, Utica, N. Y.

PHILADELPHIA ELECTRICAL & MANUFACTURING COMPANY, Twentieth and Commerce Streets, Philadelphia, reports that its business has increased to such an extent in the past few months that its manager, Mr. C. L. Bundy, has been compelled to secure the entire building, running through from Commerce Street to Market Street. The company has recently issued some very attractive circulars describing its new improved arc cut-out. This cut-out is inclosed in a neat little iron box, divided with procelain bushings where the wires enter, and occupies a space of about 5 by 6 inches.

MR. HUGO REISINGER, 38 Beaver Street, New York, sole agent of "Electra" highest grade Nuernberg carbons, informs us that the outlook for the present season is most promising. The large and numerous orders that have lately reached him prove not only an increase in business, but that station managers are fully aware of the advantages gained by the use of the best carbon. The European factory Mr. Reisinger represents has been enlarged recently, thus enabling him to fill orders for the largest quantities of carbons on short notice.

THE WEBSTER SYSTEM OF STEAM HEATING is being installed in various places, including the following, for which contracts have recently been closed: John Dobson Store, Ninth and Market Streets, Philadelphia, Pa.; Lockwood Company, Waterville, Me.; the Tyler Wire Works Company, Cleveland, Ohio; factory building of Thomas Boggs, Philadelphia; Snellenburg Building, Twelfth and Market Streets, Philadelphia; J. M. High Building, Atlanta, Ga.; Wilkesbarre Hotel, Wilkesbarre, Pa.; Monticello Hotel, Norfolk, Va.; Adams Express Company Building, Cincinnati, Ohio; Grand Central Station, New York City.

P. & B. PRODUCTS.—It is at this season of the year that street railways and electric light companies are making repairs and are in need of a good insulating tape and motor cloth. The Standard Paint Company's "Rubberoid" motor cloth is extremely elastic, strong and durable, and is meeting with a large sale. The company will be glad to send free samples to anyone who desires them. It is also making a specialty of a cheap paint for iron work, conduits, etc. Notwithstanding its price this paint is said to be much more durable than many of the so-called insulating paints and varnishes that are now on the market. The P. & B. compound is increasing in sales daily, and is in use by electricians everywhere.

THE FOSTER ENGINEERING COMPANY, Newark, N. J. has received many large orders recently, among which may be mentioned seven 10-inch valves for the Madison Avenue electric railway line, New York City; other 12-inch, 10-inch and 8-inch orders, and a contract for sixty-three valves for three United State battle ships under construction by the Newport News Ship Building & Dry Dock Company. Another order was for 104 valves, in sizes ranging from 3¼ to 3 inches, for the new office building now being erected on the corner of Broadway and Rector Street, New York City. In addition to these orders the company's agent in Great Britain has ordered a full line of Foster regulators up to 12 inches inclusive, and the agent on the Continent has placed orders with Krupp in Germany, and for railroads of Russia, Germany, France, Holland, Austria, Belgium and Switzerland. These foreign orders, together with orders from home railroads, industrial establishments, electric plants, etc., have kept the company's works busy in every department. The company reports that its October and November business has broken all previous records.

Business Notice.

THE KLONDIKE COUNTRY AND COLORADO are now the two principal gold mining fields in the world. We can give you information about both, but as the Klondike country will be impenetrable until next summer, why not go to Colorado this fall and look over the golden opportunities of that State? It is cheaper and easier to go to Colorado, and we will venture dollars to doughnuts that more net money can be made in Colorado in twelve months, with less capital, than in the outskirts of the Arctic Circle during the same period, at forty times the expense. Ask the nearest agent for he price of tickets to Denver, Leadville or Cripple Creek, and tell him to send you via Chicago and Omaha over the Chicago, Milwaukee and St. Paul R'y, in the through sleeping car from Chicago to Denver. For further information, address E. F. Richardson, General Agent Passenger Department, 381 Broadway, New York City.

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED NOVEMBER 30, 1897.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

594,379. ELECTRIC SYSTEM OF PROPULSION; W. M. Brown, Johnstown, Pa. App. filed May 11, 1897. In an electromagnet adapted to travel over fixed contacts and close the circuit between said contacts and the source of supply, energizing coils comprising a winding of comparatively high resistance connected to both sides of the circuit, in combination with a winding of comparatively low resistance, placed in series with motors for propelling a vehicle, said windings being adapted to simultaneously co-operate in energizing the magnet.

594,382. SIGNALING SYSTEM; H. A. Chase, Boston, Mass. App. filed Jan. 23, 1893. Renewed May 22, 1897. In a signaling system, the combination of the following instrumentalities, viz., a signal transmitting apparatus constructed to transmit a number of impulses indicative of the apparatus and additional impulses indicative of different signals, of a receiving instrument or relay responsive to all the impulses transmitted, an audible signal normally passive or non-responsive to the impulses indicative of the apparatus, and a controller for said audible signal governed by the relay and controlling the operation of the audible signal to cause the said audible signal to become responsive to each additional impulse indicative of the different signals.

594,386. ELECTRIC CONTACT DEVICE AND CONDUCTOR CONSTRUCTION THEREFOR; J. McK. Dortch, Johnstown, Pa. App. filed Jan. 19, 1897. An electric contact device carried by the conductor, having a plurality of supporting portions, and cam faces substantially in alignment with the conductor hangers.

594,403. OVERFLOW ALARM; C. Johnson, Chicago, Ill. App. filed Sept. 18, 1897. In an overflow alarm for water receptacles and the like, the combination with two terminals of an alarm bell circuit, of a member normally positioned above the terminals, and a body capable of floating and normally located in the air above the water, and substantially at high water level, said member being conditioned to fall and connect the terminals when the water in the receptacle reaches said level and touches said body.

594,406. TRAVELING CONTACT DEVICE FOR ELECTRIC RAILWAYS; M. D. Law, New York, N. Y. App. filed July 8, 1896. A traveling contact device for conduit electric roads, comprising a supporting bar, a frame of insulating material carried by the same, a contact piece and a spring arm for supporting the contact pieces, comprising a single piece of spring metal bent into a coil between its ends, and attached at one end to the frame, and carrying the contact piece at its opposite end.

594,407. TELEPHONE LINE SWITCH; G. Lay, Licking, Mo. App. filed Oct. 10, 1896. A telephone line switch, comprising a movable pair of connected metallic arms, a second pair of such arms, insulated bridging strips on one arm of each pair, and stationary contact points connected to the line wires, and an intermediate connecting plate spanned by the bridging strips.

594,410. GEOGRAPHICAL CLOCK; H. Margolis, New York, N. Y. App. filed July 29, 1897. In a geographical calendar timepiece, the combination of a map disc adapted to revolve, a stationary ring graduated for hours of the day, a disc graduated for the days of the week, and mounted on a portion stationary with the ring, the said disc being arranged to disclose always two days of the week, means whereby the said disc may be partially rotated step by step relatively to the revolution of the map disc, and a line of demarkation carried by the map disc indicating the international dividing line between the days of the week.

594,426. ELECTRIC ARC LAMP; H. R. Quinby, Rochester, N. Y. App. filed Feb. 18, 1897. In an electric arc lamp, the combination with the movable armature, having a tapering recess, of a carbon clamp embodying a collar through which the carbon passes, movable in said recess, having radial apertures, and balls arranged in said apertures and engaging the walls of the tapering recess, and also the carbon, and a releasing projection co-operating with the clamp collar.

594,435. COMBINED GAS AND ELECTRIC GENERATOR PLANT; S. H. Short, Cleveland, Ohio. App. filed May 4, 1896. In a combined gas and electric generation plant, a gas retort, means for heating the same, a coke holder adapted to receive the coke from said retort, a material electro-negative with respect to such coke, an electrolyte intervening between said electro-negative material and the coke, means for supplying oxygen to said electrolyte, through said electro-negative material, and means whereby the electrolyte and the electro-negative material are heated by the products of combustion of said retort-heating means.

594,470. ELECTRIC SWITCH; G. W. Hart, Hartford, Conn. App. filed April 20, 1896. In combination with a rotary switch plate, a handle, a cover plate, through which the shank of the handle extends, an index mounted in the opening in the cover plate and underlying the handle, and means for locking the index in the desired position of adjustment with reference to the handle of the switch plate.

594,471. ELECTRICALLY CONTROLLED BLOCK SIGNAL FOR RAILWAYS; R.J. Hewett, St. Louis, Mo. App. filed Aug. 20, 1896. In a railway signal system, a block having a plurality of insulated track sections, each section being provided with an independent track circuit and a forward and rear signal for the block for each direction, distinguishable in character, one in advance and the other in the rear of the controlling train, each set being included in a circuit controlled by a relay in its governing track circuit, and electromagnetic devices for locking the relay against change until the block is vacated.

594,488. POLYCIRCUIT DYNAMO; I. R. Prentiss, Cleveland, Ohio. App. filed Nov. 9, 1896. A multipolar dynamo-electric machine, having separate independent circuits, each connected with part of the poles and their corresponding brushes, and disconnected from the other poles and brushes.

594,489. POLYCIRCUIT DYNAMO; I. R. Prentiss, Cleveland, Ohio. App. filed March 31, 1897. In a multipolar dynamo, a closed coil armature having the brushes under each pair of field magnets of opposite polarity, connected in series with an external circuit.

594,493. ELECTRIC BRAKE; S. H. Short, Cleveland, Ohio. App. filed May 10, 1897. In a brake system, the combination with circuits closed upon themselves in a closed magnetic field, and of means for inducing heavy currents in said closed circuits.

594,514. AUTOMATIC HIGH PRESSURE ALARM; C. W. Bemish, Tacoma, Wash. App. filed Jan. 9, 1897. The combination with a pressure gauge, provided with a non-conductive dial, and with a metallic alarm dial provided with graduated apertures, of a contact plug, an alarm circuit having both terminals wrapped upon the plug, one of said terminals being insulated therefrom, and a hand movable over the face of the gauge and mounted edgewise, said hand being designed to make contact with the insulated terminals of the alarm circuit, and to hold said circuit closed during a predetermined movement of the hand.

594,585. ELECTRIC ARC LAMP; T. E. Adams, Cleveland, Ohio. App. filed Jan. 21, 1897 The combination with a lamp arm, having a pin or projection thereon, of a carbon guide constructed with a body portion adapted to permit the unobstructed passage of the carbon and terminating at one end in an arm adapted to engage the pin or projection on the lamp arm, an upwardly and inwardly projecting finger projecting from said body portion, so as to engage the carbon.

594,614. MECHANISM FOR MAKING, BREAKING AND SWITCHING ELECTRIC CIRCUITS FOR RAILWAY SIGNALS; P. H. Forbes, C. C. French and A. Lee, Topeka, Kan. App. filed March 26, 1897. A mechanism for making and breaking an electrical wire signal circuit, comprising a depressible bar disposed parallel with the track rail, a suitably journaled rock shaft, an arm on the rock shaft connected to said bar, a finger on the rock shaft, a contact spring in the path of the said finger, circuit wires connected to said contact elements, an arm on the rock shaft, a threaded rod secured to this arm, an adjusting nut on the threaded rod, a guide for the rod against which the nut lodges, a retractile spring secured to the threaded rod, and means connected to the rock shaft to retard the return movement of the depressible bar and separation of the contacts.

594,618. ELECTRIC SWITCH; M. Guett, Hartford, Conn. App. filed May 29, 1897. In an electric switch, in combination, a locking plate arranged to be oscillated between two normal positions, means for oscillating the plate beyond those normal positions, a locking lever loosely connected with the poles, and arranged to engage a portion of the plate until it is oscillated beyond either one or the other of these normal positions, a spring engaging the plate, and also a part connected with the poles, and arranged to be put under tension by the oscillation of the plate, said spring, when under tension, being adapted to throw the poles and to move the plate to either one or the other of its normal positions, and poles mounted upon a spindle and adapted to be oscillated when the locking lever moves.

594,656. ELECTRIC SWITCH; F. Schwedtmann, St. Louis, Mo. App. filed Dec. 14, 1896. In an electric switch, a suitable contact part, a switch blade adapted to make contact therewith, a solid pivot post carrying said switch blade, and having formed in it a slot at the termination of the opening for the reception of the said switch blade, and a contact spring firmly secured in said slot, with the free end between said pivot post and said switch blade.

594,657. LAMINATED CONVERTER CORE; F. Schwedtmann, St. Louis, Mo. App. filed April 5, 1897. In an element for laminated converter cores, consisting of a T-shaped plate, having two short arms and a long arm, and two similar substantially U-shaped plates, each having a long arm and a short arm, the ends of the long arms of said latter-named plates abutting the ends of the short arms of said T-shaped plate, and their short arms abutting the end of long arm of said T-shaped plate.

594,665. ELECTRIC BRAKE; W. Weihl, New York, N. Y. App. filed Oct. 22, 1896. In a brake for electrically propelling vehicles, the combination of electromagnets mounted to vibrate, an operative connection between the said electromagnets and the brake beam, means for closing a circuit through the electromagnets, a hand brake provided with a gear wheel, a brake rod connected with the operating lever of the electric brake system, and provided with a rack engaging with the gear wheel on the hand brake, and a ratchet wheel and pawl in connection with said hand brake.

594,678. ELECTRIC BURGLAR ALARM; T. A. Clarke, Bootle, England. App. filed Jan. 12, 1897. In a burglar alarm wedge, the combination of the two portions forming the upper and lower parts of the wedge with a series

of thin contact plates, forming the hinge, and arranged with contacts of opposite polarity, side by side, and covering a greater portion of the surface of the wedge, whereby if a metal tool be used to push it away it will complete the circuit by bridging the distance between two contacts.

594,682. ELECTRIC ARC LAMP; T. E. Drohan, Chicago, Ill. App. filed July 9, 1897. In an electric arc lamp, the combination with a longitudinally movable tubular portion through which the carbon may freely pass, of a clutch lever pivoted to said tubular portion and normally engaging the carbon, a stop in the path of said clutch lever adapted to engage therewith and cause the same to release the carbon, means for preventing the engagement of the clutch lever with said stop to prevent the total release of said carbon from the tubular portion after it has passed a given point therein, and electromagnetic means for causing the movement of said tubular portion to effect thereby the regulation of the lamp.

594,687. COMMUTATOR; C. J. Greiner, St. Louis, Mo. App. filed Aug. 31, 1897. In a commutator, a commutator cylinder; said commutator cylinder having a periphery consisting of metal segments of equal dimensions circumferentially, one-third of said segments being twice as long as the others, and said segments being arranged with a long segment and a short segment alternating, and with a short segment in longitudinal alignment with each long segment, and with a non-conducting surface in longitudinal alignment with each of said alternate short segments, and each of said metal segments insulated from the others, and with said longitudinal-aligned short segments out of circumferential alignment with said alternate short segments; electrical connections between said short segments and the armature, brushes mounted to contact with said commutator cylinder and electrical connections leading to said brushes.

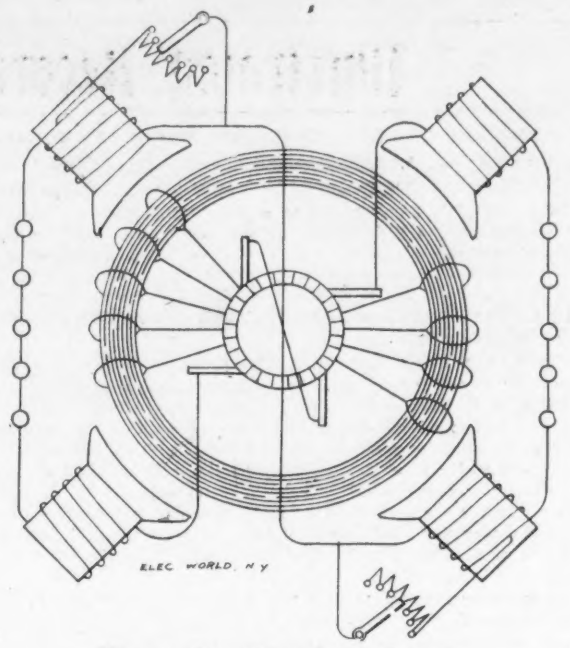
594,702. ELECTRIC RAILWAY; R. Lundell, Brooklyn, N. Y. App. filed Aug. 24, 1896. An electric railway system provided with a current feeder, or main, normally open branch feeders, conducting contact buttons, and sectional trolley rails or conductors, in combination with electromagnetic switching devices provided with pairs of switching contacts and circuit conductors, whereby any surface leaking current to the switching magnets from the current feeder or main after a car has passed a given switching magnet will always be conveyed therethrough in a direction the reverse of that taken by the working current, while the car or vehicle is being propelled over the route.

No. 594,410.—Geographical Clock.

594,744. MEANS FOR CONTROLLING ELECTRIC CURRENTS; P. Kennedy, Brooklyn, N. Y. App. filed April 28, 1897. In a device for controlling electric currents, the combination with a dynamo, an external circuit fed by said dynamo, a rheostat in the field magnet circuit of the dynamo, and a solenoid in the said external circuit, said solenoid having a movable core and a spring connected therewith, of the said spring and core, the latter provided with pawl operating branches, a rotatively mounted shaft, a contact finger carried by said shaft and adapted to move over the coil terminals of the rheostat, ratchet wheels fixed on said shaft, a crank shaft driven from the armature of the dynamo, the rocking pawl carrier rocked by said crank shaft, and spring pawls carried by said pawl carrier and adapted to engage the respective ratchet wheels, and branches on the core of said solenoid being adapted to shift said pawls, respectively, into and out of engagement by the movement of the solenoid core.

594,745. POLE CHANGING MECHANISM FOR ELECTRIC GENERATORS; P. Kennedy, Brooklyn, N. Y. App. filed April 26, 1897. The combination with a dynamo, of a shifting helix, having two relatively shallow circumferential grooves and a deeper spiral groove, connecting said two circumferential grooves and forming deflecting shoulders at the points of intersection therewith, a shifting lever, having a stud which engages a groove in said helix, gearing between the armature of the dynamo and said helix, whereby the former rotates the latter, and a pole changer connected with and adapted to be operated by said shifting lever when the direction of rotation of the dynamo is reversed.

594,779. REGULATING ELECTRIC MOTORS; A. G. Davis, Washington, D. C. App. filed July 17, 1897. The combination of a plurality of motors coupled in tandem, with phase advancing devices adapted to neutralize, in whole or in part, the self-induction of the intermediate circuits.

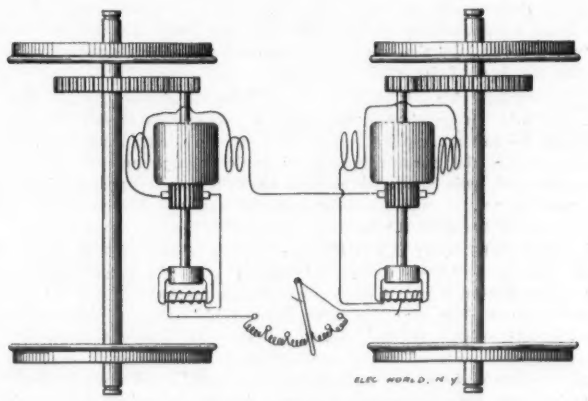


No. 594,489.—Polycircuit Dynamo.

594,800. ELECTRIC RAIL BOND; S. W. Huff, Baltimore, Md. App. filed March 11, 1897. A bond for electrical connections, comprising a flat metal body portion composed of a number of parts which render it flexible edgewise, and attaching lugs integral with the ends of said body portion, and formed of the same original body of metal as said body portion.

594,807. TROLLEY GUARD; L. H. McNett, Eldora, Ia. App. filed July 25, 1896. A trolley, comprising in combination, a pole or mast, having at its upper end a bifurcated head or fork, part of which is webbed at top near crown; an electric conducting wire; a grooved wheel journaled between the arms of said fork and running in contact with said wire; a pair of side guards each extending and continuing from said fork ends outward and upward above said wire, and having an aperture through each transversely; a pair of levers pivoted in recesses in said head, the outer end of said levers operating in said apertures and terminating in fingers turned angularly toward each other, the ends meeting centrally above said wire to form a top guard, which, when closed, together with the wheel and side guards, incloses said wire in section, said levers having the opposite ends connected each to a cord running over guide rollers and downward to afford means for manipulating said levers and top guard fingers, and suitable springs supported to normally press said finger ends together.

594,832. LOCOMOTIVE FOR TOWING CANAL BOATS; E. A. Leland, Great Barrington, Mass. App. filed Feb. 20, 1897. The combination of a railway track, having its rails provided with lateral flanges, and a rack continuous with said track, and provided with laterally projecting teeth, of a motor car, having wheels running on the track rails, brackets depending from the car truck on each side, and carrying rollers to run on the under side of the rail flanges, a vertical shaft mounted on said car, and provided at its upper end with a worm wheel and at its lower end with a pinion in mesh with said rack, a horizontal shaft mounted on the car, and provided with a worm in mesh with the worm wheel of said pinion shaft, and a motor for rotating the said worm shaft.



No. 594,493.—Electric Brake.